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THE SEA OTTERS OF THE COMMANDER ISLANDS

BY I. BARABASH-NIKIFOROV

The biology of the sea otter (*Enhydra lutris* Linn.) has been very little studied until recently. Our information about this rare and interesting animal has been almost entirely limited to the data published by Steller in 1751. Since Steller's time there have appeared only a few articles, and these have been limited mainly to discussions of the existing stocks of sea otters in particular localities or of a few of the animal's habits.

From 1930 to 1932 I made observations on the sea otters of the Commander Islands. During this period I was able to study their entire life cycle, and to gather much important information.

SIZE AND WEIGHT

The average normal measurements of the sea otters of the Commander Islands are as follows: Body length somewhat over 1,000 mm.; tail length about 320 mm. The weight is approximately 30,000 grams. The maximum size recorded is a length of 1,460 mm., with a weight of 37,000 grams. The average size and weight at different ages are given in table 1.

EXTERNAL CHARACTERS

The color of the sea otters of the Commander Islands varies from almost red to a deep black, but the most typical color is a dark brown evenly distributed over the whole body with the breast and lower part of the neck standing out conspicuously by their lighter tint. Sometimes the entire head and fore part of the body is of a light straw or cream color. When first born the young have fur of a light reddish-fawn. This changes to the color of the adults by the time the young are a year old. The occurrence of gray-tipped hair in the outer coat apparently has no connection with the age of the animal, since alongside of young otters having a considerable amount of this gray-tipped hair, old ones were sometimes observed with none at all.

The fur is longest along the middle of the back, where it reaches an average length of 27.7 mm. On the sides it gradually shortens to a length of 25.9 mm., and on the belly to 23.4 mm.

In general the coloration of the individual hairs is as follows: On the basal third the color varies from wood-brown to a light cinnamon-drab (Ridgway, Color Standards

and Nomenclature, 1912). The color becomes stronger on the second third, finally deepening to a bone brown at the ends.

The fur of the sea otter is so permeated with oil that it rarely becomes water-soaked in the sea.

PELAGE REPLACEMENT

With regard to the shedding of the fur it must be stated that, as with propagation, there is no definite season during which it takes place. The animals shed their fur very gradually. When otters were hunted commercially, specimens in the process of shedding were caught throughout the year.

In examining the excreta of the sea otter, more than once we found considerable quantities of hair—resulting from the licking of the coat. Naturally during the period when the shedding is most rapid, considerably more hair is swallowed than at other times. We found the greatest quantity of hair in droppings examined during the summer (June and July). An examination of the otters' beds showed the loose hair sticking to the snow and rocks most abundantly in May and early June.

TABLE 1

Average sizes and weights of the sea otter

AGE	LENGTH OF BODY	LENGTH OF TAIL	WEIGHT	NUMBER MEASURED
	mm.	*mm.*	*grams*	
Embryo	307.0	130.0	1,400	1
Newborn	440.0	155.0	2,000	1
About 5 months	585.0	200.0	5,600	1
1 year	703.5	262.5	11,300	6
2 years	806.0	297.0	19,000	36
3 years	905.0	310.0	21,200	75
4–5 years	1,015.0	316.0	23,800	17
5–6 years	1,056.5	320.5	25,500	7
6–7 years	1,138.8	322.3	30,200	5
7–8 years	1,207.6	324.0	32,500	4
8 years and over	1,304.9	330.0	35,000	2

HABITAT AND GENERAL HABITS

The principal habitat of the sea otter about the Commander Islands is the rocky Copper Island in the northwestern part of the group. Here the otters gather in large numbers and pass through their entire life-cycle. An analysis of the records of the commercial exploitation of the sea otter over a considerable number of years indicates that the proportion of the sexes in the herd is unequal—there are more males than females, in the ratio of about six to four. The yearly increment of the herd is about 7 per cent. The entire herd does not number more than 600 to 700 head.

Copper Island, which the sea otters have made their chief habitat, has steep, rocky shores around which the sea constantly boils and foams. There are reefs both under water and projecting above the surface. A broken line of patches of seaweed (*Alaria fistulosa*) growing in the shallower waters, extends along the shore. This seaweed, growing in water with a maximum depth of ten meters, rises in thick masses to a height of six to eight meters above the sea bottom, and forms a real submarine forest. It dies down in winter, but the roots remain and the growth is renewed in the early spring. The sea otters like these seaweed growths and spend much time in them; but it can hardly be

food that attracts them there, as some authors have supposed, since it is impossible to discover in these places any considerable quantity of fish or of invertebrates. In fact as compared with other seaweeds (e.g. *Laminaria dentigera* and *Thalassiophyllum*), *Alaria* always has a striking poverty of inhabitants. It seems more reasonable to suppose that the sea otters are attracted to these growths of seaweed because of the comparative calmness of the sea there. Certainly the sea is much calmer in these places. The indications are, also, that the otters that frequent these spots are "at rest" and not feeding. Patches of *Alaria* growing at a distance from the island probably serve, like the rocks that rise above the surface, as stations or hiding places where otters in passage may rest in quiet and safety, protected from the killer whales. In winter, when these outlying shelters disappear, the otters remain near shore where they can find protection from the frequent terrible storms.

The sea otter is an aquatic rather than a terrestrial animal. Though its peculiarly built fore limbs still resemble those of land animals, the fact that its hind extremities have been transformed into pinnae, and a number of other distinctive characteristics, indicate its admirable adaptation to a marine habitat. The animals feel much more secure and at home in the water than on land.

The sea otter swims at a good speed, its muzzle stretched forward and its flippers working energetically. From time to time it dives, and frequently it thrusts its body perpendicularly above the surface to look about. When startled it dives immediately, and when swimming under water it oscillates its body and tail with a wave-like motion.

The sea otter has a habit of lying quietly on the surface of the water. When in this position it presents a strange spectacle. Flat on its back, belly upward, its head bent a little forward on its breast, it often remains thus for a long time, rocking on the waves like a cork. Its webbed hind feet and flat tail spread out behind in a horizontal plane keep the body steady in this peculiar posture. Sea otters feed and the females nurse their young, while thus lying on the water. When nursing the mother holds her young to her breast.

The sea otter uses its front flippers like hands, managing them deftly when devouring its prey, performing its toilet or nursing its young.

The otter's voice is a loud squeak which, at a distance, resembles a whistle. Apparently it is not an alarm note, as observation shows that it does not disturb the other nearby otters.

Sea otters are diurnal animals, sleeping at night on shore or on isolated rocks, only plunging into the water if disturbed. They generally choose a spot not more than ten meters from the water's edge. Their beds are generally marked by heaps of excrement and by very characteristic trails left in the snow. These latter are in the shape of an arch or horse-shoe, the ends of which run into the sea. The broad top of the arch is formed by the bed, the sides are formed by the tracks made when the animal goes to and leaves the bed. Judging by the exit tracks, which are almost always a direct continuation of the entrance tracks, it appears that the sea otter passes the entire night without changing its position. By preference the bed is located in the shelter of some spur or projecting rock, and the direction of the exit tracks seems to indicate that the animal lies with its head pointing up the wind.

As regards the organs of sensation it may be said that the sense of smell is the most highly developed, and those of sight and hearing are much less acute. The pads of the front paws and the whiskers serve to some extent as organs of touch. By means of them the animals easily distinguish objects under water and rarely make an error in selecting their food there.

Sea otters are remarkable for their peaceable and equable disposition; we have never observed any fights among them, and whenever we noticed two of them plunging about in the water together, they seemed to be playing rather than fighting. We have never

noticed any indications of social organization, such as a recognized leader or the like.

The degree of activity of the sea otter depends on the following factors: on the degree to which the animal is satiated with food, on the local food supply, on hydrometeorological conditions, and on the instinct of propagation. The otter is most active in the early morning. After leaving its bed it proceeds energetically to satisfy its hunger; when it is gorged it comes out on the rocks or rests on the surface of the water. It resumes its activities about noon; and several such alternating periods of activity and rest may be observed during the day. It settles down for the night soon after sunset and it was only very infrequently that we observed it moving during the night, and then on moonlight nights.

The sea otters behave in an unusual manner before a change of weather. Sometimes on a clear morning we would observe otters splashing about and whirling in the water like a wheel, and when this happened there was almost always a heavy snowfall or other marked change in the weather by evening.

From time to time the otters gather, in larger or smaller numbers, at different places. It is rarely possible to establish any regularity about these movements, nor is there any apparent external reason for them. No doubt strong winds and rough seas sometimes drive in the otters that are far from the island, thus increasing the number near the shore. The tendency, especially of the females with their young, to seek out sheltered spots during stormy weather, may also increase or decrease the number of animals at any given place. There are very few otters near the coast in calm weather.

Though the sea otter gives no indication of becoming attached to any special habitat, it makes no regular migrations. A few individuals may wander, but it is difficult to say what is the cause of such movements.

FOOD AND FEEDING HABITS

The question of the sea otter's food is of great interest. Since the animals are not being hunted at the present time, it has been impossible for me to examine the contents of their stomachs. The only available methods of studying food habits were (a) direct observation of the otters while feeding and (b) analysis of excreta. The latter method has given the best results. An examination of fresh droppings, gathered as regularly as possible from the otters' sleeping places, has enabled me to get a clear picture of the character of the food at all seasons.

From most of the objects eaten, undigested solid parts remain by which the different foods can easily be distinguished. An exception to this rule is in the case of the octopus which, from our direct observations of the otter, we know is eaten in great quantities; yet remains of this animal (the solid parts around the mouth) are found only in very limited amounts in the droppings. Evidently the sea otter eats only the bodies and rejects the heads.

Examination of about five hundred droppings shows that the different kinds of food represented in them are as follows:

	Percent
Sea urchins	59.00
Mollusks	23.30
Crabs	10.00
Fish	6.70
Seaweeds and accidental admixtures	1.00
	100.00

From this it appears that sea urchins constitute the principal article of food. There are several species of sea urchin near the islands, of which *Strongylocentrotus polyacanthus* and *S. droebachiensis* are of special importance as regards the subject under

discussion, since their remains in the form of minute fragments of shells and spines generally make up the greater part of each sample of excrement. Occasionally these remains occupy second place but they are rarely entirely absent.

Among mollusks such bivalves as *Mya*, *Spisula*, and more rarely *Mytilus*, are the principal kinds used as food.

Though remains of the octopus (*Polypus*) are rarely found in the droppings, this fact does not correctly indicate the importance of this animal as a source of food. Remains of *Natica* are occasionally found, those of *Volutopsis* very seldom. There are at least two kinds of crab that are eaten by the sea otter: *Telmessus cheiragonus* and *Chionoecetes opilio*. More rarely *Hyas* sp. and some others are found. They, as well as fish, constitute a considerable part of the animal's summer food. Most of the local species of fish, ranging from the smallest (*Ammodytes*, *Mallotus*) to large ones such as the cod (*Gadus*) are eaten by the otter.

The small fragments of seaweed occasionally found in the excreta are quite unchanged and undigested. It is probable that they are swallowed unintentionally in the process of seizing and devouring the animal food.

The change in the composition of the food according to season is quite evident, and is basically as follows. The winter food consists chiefly of sea urchins and mollusks, while the summer food is considerably enriched by fish and crabs.

The otter feeds chiefly in shallow waters, as is shown by direct observation and by the littoral animals and seaweeds found in the excreta.

The otter, which habitually swims on its back, belly up, holds its food on its chest, and uses its fore flippers while eating. An animal will sometimes gather as many as ten sea urchins with one sweep of its flipper. The sea urchins are then held on the otter's chest by the flippers and by deep folds in the skin. The powerful molar teeth grind the food very fine, but nevertheless fragments of mollusk shells up to 30 mm. in length are sometimes found in the excreta. The otter avoids masticating such hard objects as the shells of *Natica* and *Volutopsis*. It is evident that the otter is able in some way to extract the body of the mollusk without cracking the shell. It also does not break the shell of the hermit crab (*Pagurus*).

BREEDING HABITS

In studying the breeding of the sea otter we find that there is no definite mating season. It is therefore difficult to determine the duration of the mating period or that of pregnancy, or the age when the animals become sexually mature. Mating play was observed in winter as well as in summer. It is most frequent in spring. Coitus was noted in 1931 on January 28, March 20 and 25, April 15 and 26, and May 21; in 1932 on January 2 and March 28.

The young are born well developed and with a complete set of teeth. I therefore suppose that the period of pregnancy is about 8 or 9 months.

The sea otter whelps on shore or on rocks that rise above the water. On April 15, on a rock, we found a female otter that had so recently whelped that we were able to obtain the placenta. This was a very unusual find, since the placenta is generally washed away almost immediately by the waves. On one occasion we were able to observe a female while whelping.

The female bears only one young at a time. It is very exceptional to find two developed embryos in the uterus of a sea otter, as we did once in 1910.

The mother otter shows much affection for her pup, and takes great care of it. She carries it on her breast, licks, scratches and bathes it, and handles it with her flippers. The pup remains with the mother for a long time. Very frequently one large enough to swim and feed itself will still be seen with its mother. Sometimes the mother otter will hold her young one by its back while both of them swim in an upright position.

While observation of sea otters in a state of nature does not give sufficient grounds for assuming the existence of polygamy among them, nevertheless it does not confirm Steller's idea of the unusual inseparability of the pairs. The females with their young often gather in groups separate from the males or swim about alone almost all day. In general it may be said that it is very difficult to identify and observe definitely mated pairs.

There is no basis for the supposition that the sea otter is degenerating. A histological examination of the testes of the animal gives a picture of quite normal, active spermatogenesis with no indication of degeneration.

COMPETITORS, ENEMIES AND PARASITES

We find in Steller the statement that the sea otter fears the seal and will not remain in its vicinity, but our observations do not corroborate this. When sea otters and seals meet one another while swimming they pass quietly, each going its own way and paying no attention to the other.

The relationship between sea otters and sea gulls is very interesting. The gulls are, to a certain extent, "boarders" of the otter. One can often see small groups of gulls obstinately besieging the otter as it eats; the birds seize upon any scraps of food dropped by the animal and sometimes fairly snatch them out of its very paws. In an attempt to rid himself of these persistent hangers-on the otter often dives, but as soon as its head reappears above water the gulls surround it once more.

The various seals (*Eumetopias jubata*, *Callorhinus ursinus*, *Phoca ochotensis macrodens*) that are most commonly found at Copper Island are, to a greater or less degree, competitors of the sea otter for food. The killer whale (*Orcinus orca*) which, according to some observers, attacks the otter in the sea, may be considered an active enemy.

At the present time the mortality of the sea otter is very low. Among the causes that contribute to the death rate among these animals may be mentioned the following: old age; unknown diseases; storms (old and weak otters are sometimes killed on the rocks); pathological delivery; rock slides where the sea otters bed; and injuries inflicted by the killer whales. Instances of the destruction of sea otters by poachers are not observed now.

It appears that the sea otter is not infected with parasites to any considerable degree. In examining the excreta single specimens of nematodes were sometimes found and a complete helminthological examination of the internal organs of one sea otter gave the following results: In the stomach, 17 small and 3 large nematodes; in the small intestine, 19 small nematodes and 3 cestodes; in the large intestine, 7 small nematodes; in the rectum, 6 small nematodes. No parasites were discovered in the other organs. During the examination of the digestive tract of another sea otter large nematodes were found as follows: In the oesophagus, 1; in the stomach, 13; in the small intestine, 2. Two cestodes were also found in the small intestine.

All the nematodes discovered proved to belong to the species *Porrocaecum decipiens* (Krabbe) in different stages of development. They are generally found to infest the pinnipeds. The cestodes could not be identified.

We found only two specimens of ectoparasites, which proved to be similar to (and possibly identical with) the species *Echinophthirius fluctus* (Ferris).

LITERATURE

ANONYMOUS. 1894. Investigation on sea otter and fur seal. Publ. Fisheries Society of Japan, Dept. Agriculture and Commerce, Tokyo, pp. 104, pls. 6. (In Japanese. Contains tables showing number of sea otters taken by foreign sealing vessels to Hakodate and Yokohama from 1878 until 1893; number of skins

brought to port of Yokohama by foreign sealing vessels from 1877 to 1885; a special report of Captain of Japanese war-ship on foreign sealing industry on southern coast of Hokkaido during 1893; number of sea otters brought by Japanese to Hokkaido between 1872 and 1892; number of sea otters caught by Fish Commission of the Japanese Government from 1889 to 1892; and a general account of the sea otter.)

ELLIOTT, HENRY W. 1875. A report upon the condition of affairs in the Territory of Alaska. House Exec. Doc. no. 83, 44th Congress, 1st session, Washington, pp. 277. ("The sea otter and its hunting," pp. 54–62.)

SCAMMON, CHARLES M. 1874. The marine mammals of the north-western coast of North America, described and illustrated: together with an account of the American whale-fishery. San Francisco: John H. Carmany & Co., pp. 319 + v, pls. 27. (The sea otter, pp. 168–175.)

SNOW, H. J. 1910. In forbidden seas; recollections of sea-otter hunting in the Kurils. London: Edward Arnold, pp. xiv + 303, pls. 15, map.

STELLER, GEORGE WILLIAM. 1751. De Bestiis marinis. Novi Commentarii Acad. Sci. Imp. Petropolitanae, vol. 2 (1749), pp. 289–398, pls. 14–16.

———. 1899. The beasts of the sea. (Translated by Walter Miller and Jennie Emerson Miller). In: Jordan, David Starr. The fur seals and fur-seal islands of the North Pacific Ocean. Commission on fur-seal investigations—1898–99, U. S. Treasury dept. doc. no. 2017, Washington, pt. 3, pp. 179–218.

TAYLOR, WALTER P. 1914. The problem of aquatic adaptation in the Carnivora, as illustrated in the osteology and evolution of the sea-otter. Univ. Calif. Publ., Bull. Dept. Geol., vol. 7, no. 25, pp. 465–495, figs. 15. January 22, 1914.

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A NATURAL HISTORY STUDY OF MICROTUS CALIFORNICUS

BY DONALD M. HATFIELD

The following account of the life history of *Microtus californicus* is based largely upon two years study at the Museum of Vertebrate Zoology. Most of the work was done with caged individuals, but observations of a general sort were made also on meadow mice in the wild.

The laboratory cages built to house these mice were constructed in units, each unit with inside measurements of 33 by 10 by 8 inches high, and each unit was divided into three cages, each of these with inside measurements of 11 by 10 by 8 inches high. The materials used were one inch pine and ½ inch mesh wire. A removable galvanized iron tray was fitted into the bottom of each cage. In the finished unit, the cages are separated from one another by the ½ inch mesh wire only. Mesh of this size allows the mice to become "acquainted" with one another, and yet prevents injury through fighting. In attempting to breed these animals, one is confronted by the probability that when two strange mice are placed together for breeding purposes one will fatally injure the other. In this respect the adjacency of the cages within a unit is a great aid, since the strange male and female, when placed in ad-

joining cages, can become accustomed to one another without danger of injury. Later the two animals may safely be placed together in one cage. It is advisable that the pair be put in a strange cage rather than in either of the original cages, since each mouse considers his semi-permanent cage as private property, to be defended against any intruder.

The food supplied consisted largely of rolled oats and various kinds of greens.

Naturally, in such restricted quarters, these active animals need some sort of exercise. To provide this, I adopted Bailey's (1924, p. 527) method of placing tilted, revolving wooden discs within the cages.

SANITATION

The cleanly habits attributed to caged *Microtus* are not, in my opinion, due so much to intent as to chance. In the laboratory I have noted that, whenever a mouse reaches a corner of the cage, it usually turns around and faces the center of the cage floor. In this position, probably one of defense, it may defecate or urinate, or perform neither operation; but the fact that elimination takes place in the corners of the cage does not, it appears, mean that the mouse goes there for just that purpose.

On the other hand, I have several times in the field noted off-shoots from main runways which ended in pockets, the floors of which were covered with feces to a depth of as much as three-fourths of an inch. This suggests that in the wild state the animals do resort to special places for voiding body excrements.

FIGHTING

Meadow mice are essentially peaceful and non-quarrelsome when they are with mice known to them, but when a strange individual of their own kind appears, they become vehement fighters.

Two methods of fighting are employed. The first, the less severe, consists chiefly in the use of the front feet. These are used together to strike downward-raking blows which are more effective than one would think unless he has been made the recipient of such. The second method, more vehement than the first, often results in severe injury to one or the other of the combatants. The teeth are used extensively, and one clean bite with the incisors will tear a gaping hole in the adversary's skin, or almost cut off a foot.

Individual dispositions vary a great deal in respect to the fighting instinct; in a few instances the mice will not fight at all except in self-defense. Then again, some individuals which I have kept in captivity have been antagonistic and quarrelsome at all times, biting me upon the slightest provocation, and injuring any other mice placed with them. They produce a small clicking sound with the teeth when angry. The sound is made, according to my observation, by a fore and aft movement of the mandibles. This scrapes together the upper and lower molars.

TENACITY OF LIFE

Meadow mice are often surprisingly hardy, living through exigencies which would doubtless kill many other rodents. When trapping for live specimens, I have often caught *Reithrodontomys*, *Peromyscus*, and *Perognathus*, which, after a cold night, would be dead, hunched up in the bottom of the trap. On the other hand, *Microtus*, trapped under the same circumstances, usually were found alive and active.

INTELLIGENCE

In ascribing intelligence to an animal, one is confronted by many problems, not the least of which is where to draw the line between mere conditioned reflex and intelligence. The following are instances in which *Microtus* displayed something allied to intelligence: The exercise wheel of a pair of mice was placed against the wire side of the cage so that it could not turn. At first the mice were at a loss as to what to do; one of them would run to the top of the disk, down one side, and then stop abruptly, causing the wheel to turn somewhat. Finally the male, standing on his hind feet on the floor of the cage, with his back braced against the side of the cage, turned the wheel with his teeth and fore feet until it ran freely, whereupon he jumped on and began running. Variations of this same procedure have been noted at divers times and with different individuals.

This behavior, it seems, indicates that the mice are somewhat aware of the mechanical operation of the wheel. They must derive a certain sense of benefit from the exercise otherwise it would appear that there would be no incentive to start the wheel moving again.

Some intelligence appears to be shown in the relations between the male and female of a pair when a strange male appears. It has been noted five or six times that the strange male is immediately attacked by the other male if the female is in sight, but if she disappears into a nest box, her mate will drag her out before he starts to fight the strange male.

RHYTHMIC ACTIVITY

The mice under my observation were as a rule relatively quiet during the day, becoming more active at night. Davis (1933, pp. 232–238) has shown that *Microtus agrestis* is also more active at night than during the day. These conclusions have been based on the study of caged individuals, but observations based on trapping records seem to show, in certain instances, variations from this rhythm. My own trapping records indicate that here in Berkeley, relatively more mice are caught during the night than during the day. Seemingly in direct contradiction with this is Grinnell's (1908, p. 148) statement that, in the San Bernardino Mountains, *M. californicus* was obtained more consistently during the day than during the night. The specimens to which he refers were trapped during July and August at an elevation of around 7500 feet. Mr. R. T. Orr informs me that he has caught more specimens of the mountain-inhabiting species, *M. mordax*, during the day than during the night, and, according to her field notebook, Miss Annie M. Alexander caught more *M. montanus* during the day. In the last case, the trapping was carried on in mid-winter in central Nevada.

Now, in each of the above mentioned instances, the mice were trapped in areas in which, either because of altitude or the season of the year, cold nights were prevalent, and since the mice kept in captivity have proved to be less active in cold weather, it seems fair to assume that, in the wild state, the mice would be less active on cold nights than they would be during the warmer daylight hours. Possibly the rhythm of activity in *Microtus* is modified by localized temperature conditions.

BREEDING HABITS

Meadow mice, provided they are well-fed and kept in fairly clean cages, with a temperature as high and as variable as that in the laboratory at Berkeley, may raise as many as three litters within a two months period. They begin breeding activities early in life; the three females studied in this respect copulated when twenty-one and twenty-two days old. I observed another female mating with an older male when she was only twenty days and seven hours old. Her weight at that time was only twenty-

one grams, whereas the weight of an average adult female is about fifty grams. The males do not begin to mate until they are six weeks old, twice the age of females at first mating.

There is much individual variation among meadow mice in regard to mating activities. In certain instances mating is accomplished with very few pre-copulatory actions, but in other instances, such activity may affect the mice markedly, and be extended over periods varying from ten minutes to half an hour. I have noted two types of pre-mating actions: the first, the most usual, consists of pursuit of the female by the male. The female leads him on, often showing active dislike, but seldom fighting the male off when she is in the oestrous stage. These actions as a rule soon end in copulation.

The second type of pre-copulatory activity was observed in only two instances. The male and female met face to face on one side of the cage floor. The female started licking the male about the ears and down one side of the neck. The male remained perfectly motionless, then raised his left front leg and slowly rolled over to the right onto his back, with the female continually licking about the region of his neck, and apparently helping to push him onto his back with exaggerated vertical movements of her head. At no time, however, was the male completely on his back, his hind feet always maintaining enough traction to right him instantly should the occasion demand. This procedure ended in copulation in both instances.

The act of copulation in *Microtus* is typically mammalian. The male grasps the female just behind the front legs. The following is a record of an average copulation. The male was placed with a female next to which he had been kept for a week previous. The pre-copulatory procedure was typical in that the male followed the female persistently, and 33 minutes after the mice were placed together, the first copulation took place. There were three copulations; the first lasted eleven seconds; the second and third lasted seven and five seconds respectively. There was an interval of one and a half minutes between the first and second mountings, and an interval of three and a half minutes between the second and third. Following this third copulation, the male made still other advances to the female, all of which she met with antagonistic behavior. About forty-five minutes later, the male was removed to his own cage. Pregnancy resulted and three young were successfully reared.

The period of gestation in *Microtus californicus californicus* and *Microtus montanus montanus* was found to be approximately 21 days. The same has been found to be true of *Microtus pennsylvanicus* (Bailey, 1924, p. 528) and *Microtus californicus aestuarinus* (Selle, 1928).

Lack of exercise appears to prolong the gestation period, while undue exertion shortens it. In one instance, a female kept in a cage without access to an exercise wheel spent all her time, when not eating, in the nest box. She took 22 days and several hours from copulation time to birth of young. This animal was more than a year old; she produced only three young, whereas the number of young to the litter usually varies from five to seven.

On the other hand, too much exercise will shorten the period of gestation, even causing premature birth. Usually, it was considered necessary to place a wheel in the cage of a pregnant female for about an hour each day in order that she might get enough exercise, but in one instance the wheel was inadvertently left in the cage overnight, and in the morning the top of the disk was covered with dried blood. The abortion (?) occurred on the sixteenth day of pregnancy. This phenomenon was noted in one other instance, and under identical circumstances, though in this case abortion took place on the thirteenth day of pregnancy. The flow of blood must have been less severe in the second case, for the wheel was not as much stained as was that in the first.

Usually the female begins to build a nest at about the fifteenth to the eighteenth day of pregnancy. She is assisted in this by the male. When cotton is placed in the cage, both mice begin to shred it and place the resulting mass in a corner of the cage.

The number of young born varies directly with the age of the female. A young female will have two to four young, while an adult will bear from five to seven young per litter.

The female is, as a rule, markedly solicitous in her care of the young. She fights harder for their welfare than she does for her own protection. On several occasions I have seen a female attack a male almost twice as big as herself for coming too close to her young. However, the male and female often live in perfect harmony with a litter of young, both brooding them. This type of behavior may be unusual; for in the wild state the male mouse, as shown by what observations are recorded, is kept away from the young entirely. The harmony mentioned above exists only until the young are about a month old, at which time the male seems to resent their presence. He may then kill them if he is not removed from the cage.

The young mice will suckle for three weeks if allowed to remain with the female that long, but will thrive on oatmeal and greens alone if removed at the end of two weeks. At this time they have been observed first voluntarily to take solid food. Bailey found that the young of *Microtus pennsylvanicus* are weaned when only twelve days old, but Selle (1928, p. 97) remarks that the mice under his observation, *Microtus californicus aestuarinus*, were still suckling twenty-three days after birth, but that they had been eating some solid food for two weeks previously.

HYBRIDIZATION

While studying *Microtus californicus californicus*, of which I had numerous individuals in captivity at Berkeley, I was fortunate, when on a field trip, in being able to catch a live male and female *Microtus montanus montanus* in a meadow five miles north of Weed, in Siskiyou County, California. Numerous individuals of this latter species were raised in captivity from this pair. Several attempts were made to cross the two species, finally with one success. On February 15, 1934, four young sired by a *montanus* were born to a female *californicus*. Only one of the young, 30 days old, was alive upon my return to the laboratory after a five weeks absence in the field. This hybrid, alive at the present writing (November 27, 1934), in post-juvenal pelage resembled *montanus*; but now in adult pelage it appears to be intermediate between the two species. It possesses the small eyes and pointed snout of *montanus*, but its tail is definitely bi-colored, dark above and light below, as in *californicus*.

SENSES (TOUCH, SIGHT)

New-born *Microtus* are somewhat sensitive to touch, and to heat or cold. Any warm object with which they come in contact usually causes them to start nuzzling, perhaps in search of nipples. Furthermore, they make an attempt to conceal themselves under the object. Evidently this instinct to seek concealment is fundamental in meadow mice, since it is largely by concealment that they successfully elude their enemies.

The new-born mice are sensitive to light for some time before their eyes open. A narrow ray of light, obtained by pasting paper with a two-millimeter-wide aperture over the lens of a flashlight, was used to test the animals' sensitivity. The eyes, though still closed, are affected more by light than is any other part of the body. Even the top of the head is sensitive enough so that the animal is made aware of the stimulus, but usually no reaction occurs for a moment or two after the light strikes the top of the cranium. The reaction in both cases is usually characterized by an apparently random squirming. This may result in the animal's getting out of the direct ray of the light.

The eyes of young mice in captivity do not open until the tenth day after birth, at which time they open rather suddenly; but fully a day passes before the mice make much noticeable use of them. On the ninth day the eyelids twitch perceptibly; the upper and lower lids are evidently about to separate. Also, the lids can be seen to

contract forcibly at this stage, as though the eyes were being closed. For the first few days after their eyes open, the young mice see much less efficiently than they hear at the same age. They are able to perceive moving objects at a maximum distance of nine inches the first week. After this the visual field increases not only in length but in width. This was determined experimentally in the laboratory with caged mice. Since *Microtus* is able to hear sounds almost inaudible to the human ear, it was deemed advisable to employ a method of testing sight as noiseless as possible. The rapid movement of a piece of white gauze held in the hand proved the most satisfactory test. Since gauze is soft, a minimum amount of noise is made by its passage through the air, and rapid movement of it is startling enough to attract the attention of the mice.

As stated above, this cloth attracted the attention of the young mice only when it was moved within eight to ten inches of their eyes. At such an early age the eyeballs are not protruded as in the adult mice, and for this reason the field of lateral vision is restricted. It was rather difficult to check the exact extent of the visual field with such gross methods, but it was found that young mice are unable to see movements directly above their backs. Adults, on the contrary, possess practically a 270 degree field, both horizontally and vertically. In the horizontal plane, the "blind spot" or area lies directly behind the adult mouse, while in the vertical plane it lies beneath the mouse. This method of testing the visual field, though crude, has also shown that adult individuals of *Microtus californicus californicus* are able to perceive movements of foreign objects at distances of from ten to twelve feet by sight alone.

HEARING

There are no ear-openings in new-born mice. The future position of the external ear is indicated by a semi-circular fold in the skin. Under this fold is a strip of cartilage which, in the adult, forms the supporting structure of the pinna. Even after the external auditory meatus is visibly open, the young mice apparently do not hear for several days. Individuals raised in captivity do not respond to sounds until the seventh or eighth day; but I have noted that wild individuals five days of age (computed from weight and total length) will react to certain sounds.

Naturally, many sounds will cause the mice to react, but only a few sounds artificially produced by the experimenter regularly attract attention. "Screeping," that is, drawing air in between the lips, is by far the best test, for it invariably, in normal mice, commands instant attention, accompanied by a severe start. This sound, or more properly, combination of sounds, if correctly made by the experimenter, simulates very well the distress cry of young *Microtus*. Only in the case of very young or very sick mice does it fail to produce a reaction of some sort, usually the assumption of the "attention" posture.

The only other sound which was found to be practically constant in attracting the attention of the mice is a rustling, made by shaking dried grass, moving the shavings on the cage floor, or rubbing the fingertips lightly over a wooden surface. The last procedure, though causing sounds practically inaudible to the human ear, never fails to bring the mice to instant attention. This reaction suggests possession of a hereditary fear of some of the chief enemies of meadow mice, as for example, snakes and carnivorous mammals, which might rustle the grass in stalking the mice. Apropos of this same phenomenon, I have noted that, though mice will sometimes be out and running about in the grass on a quiet day, never have I seen one above ground on a windy day, when the grass is being blown about by the wind. The same holds true on windy nights, and here there is a more accurate check based on my trapping records. Other factors being equal, the returns from a trap line put out on a windy night average about 15 per cent less than those from a similar number of traps set out during a quiet night. It is,

of course, when the wind is blowing that an enemy can approach its prey with least possibility of being heard.

Seven-day-old mice will jump and scramble about the cage when subjected to "screeping" or "rustling." On the eighth and ninth days, just before the eyes are opened, the young mice may be brought to attention by such sounds. They will stand, listening for them, with head turned to one side or the other. They show a well-marked ability to localize the sound, running directly away from its source.

The adult mice possess a notably acute sense of hearing. It so happens that about a hundred yards from my office window there is a grove of trees in which a small colony of Steller jays (*Cyanocitta stelleri*) is present most of the year. These jays have the habit of imitating one of the call notes of the western red-tailed hawk (*Buteo borealis calurus*). The mice "freeze" on hearing it, when it is so faint as to be barely audible to me. The mice bred in captivity respond as readily to this call as do those reared in the wild.

SMELL

Observation has shown that *Microtus* possesses a relatively keen sense of smell. For instance, when a breeze blows through an open window and upon the cages, the mice become immediately attentive and move as near the source of the breeze as they are able, vibrating the nosepads vigorously. On one occasion a package of meat was left on a table about four feet from the cages. The mice immediately came to the side of the cage nearest the meat, and oscillated the nosepads violently.

At one time a mouse under my observation was blinded through fighting with another. After its wounds were healed, this individual showed itself to be aware of the presence of a strange mouse when it was introduced into the cage. Probably the primary factor in this recognition was the sense of smell, since even when the strange mouse remained quiet, across the cage from the blinded one, the latter seemed to realize the former's presence. It moved about in agitation.

GROWTH

This study of absolute growth was based on increase in weight from birth to adulthood. Each of 19 mice was weighed once a day from birth to the subadult stage (50 days), when the rate of weight increase slows down. Five litters were included, the number of young per litter varying from two to six. Following is a table of these weights, averaged for each litter, with averages for all 19 mice at the extreme right. Litter I contained 2 mice, litter II, 3, III and IV, 4 each, and litter V, 6.

An average of fifty-three grams is reached in fully adult individuals. Although old captive individuals that are excessively fat have weighed as much as eighty grams, the heaviest known individual taken in the wild in the San Francisco Bay region was a male which weighed 58.4 grams. Probably as the result of a dietary deficiency, captive mice appear to mature more slowly in respect to weight than do wild individuals.

In order that these weights might be more clearly put before the reader, I have constructed a weight curve for the average of the 19 individuals in the five litters. This has been placed so that the abscissa represents the weight in grams, the ordinate the number of days after birth.

While rearing these mice opportunity was taken to study, in detail, changes in the skull which accompanied increasing age. Without presenting the tables of cranial measurements, graphs, and other data (all on file in the library of the University of California at Berkeley) which formed the basis for my conclusions, it may be said that these, in general, correspond with Howell's (1926) findings. Briefly, although there is usually an actual increase in size of the various skull elements from youth to age, there

TABLE 1

Increase in weight in 19 mice (see text). Weights in grams

AGE	LITTERS (AVERAGE WEIGHT)					
	I	II	III	IV	V	Av.
days						
1	2.3	3.1	2.7	2.9	2.9	2.8
2	3.2	4.2	3.3	3.4	3.8	3.6
3	4.2	5.2	4.5	4.6	4.7	4.6
4	5.4	6.3	5.2	5.5	5.8	5.6
5	6.5	7.5	6.7	6.8	6.4	6.8
6	7.6	8.2	8.0	7.6	6.8	7.6
7	8.9	9.7	8.8	8.3	7.5	8.6
8	10.0	11.0	9.7	9.9	8.9	9.9
9	11.0	11.8	10.3	10.7	9.2	10.6
10	12.1	12.7	11.5	11.5	9.0	11.4
11	13.2	13.5	13.0	12.8	9.0	12.3
12	14.1	14.7	13.6	13.5	9.7	13.1
13	15.2	15.3	13.4	14.6	10.9	13.9
14	16.5	16.5	14.8	14.8	11.5	14.8
15	17.3	18.1	15.2	15.2	12.8	15.7
16	18.0	18.6	15.7	15.0	12.6	16.0
17	19.4	20.0	16.3	15.8	13.2	16.9
18	20.5	21.3	16.9	16.3	14.7	17.9
19	21.8	21.9	17.8	16.5	15.6	18.7
20	22.4	22.8	18.2	16.9	16.8	19.4
21	22.7	23.2	18.9	17.8	16.3	19.8
22	23.1	24.0	19.3	18.4	16.5	20.3
23	24.0	24.9	20.0	18.4	16.8	20.8
24	24.7	26.0	19.8	19.2	17.0	21.3
25	25.1	25.4	20.0	20.0	18.6	21.8
26	25.9	26.8	21.6	20.3	19.1	23.3
27	26.3	28.4	22.1	20.7	20.4	23.6
28	27.0	28.8	22.4	21.4	21.2	24.1
29	27.2	29.7	23.2	22.5	20.8	24.7
30	28.1	30.2	23.8	23.0	22.5	25.5
31	28.2	30.8	24.5	23.4	24.0	26.2
32	29.3	31.5	24.7	24.2	24.4	26.8
33	29.1	32.0	25.0	24.7	25.2	27.2
34	30.4	32.8	25.7	26.1	25.6	28.1
35	30.9	33.7	26.1	26.7	26.3	28.7
36	31.2	34.0	25.8	26.3	27.5	29.0
37	31.8	33.6	25.4	25.8	27.3	28.8
38	32.8	33.1	25.6	26.5	27.7	29.1
39	32.6	32.8	26.1	27.3	27.4	29.1
40	33.6	33.4	26.4	27.8	27.5	29.7
41	34.0	34.5	27.2	28.0	28.3	30.4
42	34.8	34.1	27.7	28.5	30.4	31.1
43	35.0	35.2	28.3	28.9	29.6	31.4
44	35.0	35.8	28.6	29.0	30.2	31.7
45	35.6	36.2	29.4	30.0	31.0	32.5
46	36.2	37.5	30.4	29.4	31.6	33.0
47	36.4	37.7	30.7	29.6	32.1	33.3
48	36.2	38.1	30.6	30.3	32.0	33.4
49	36.2	38.6	30.9	30.1	31.9	33.5
50	36.4	38.6	31.4	29.8	32.8	33.6

is, in almost all cases, a decrease in size relative to that of the basilar length. The occipito-nasal length, for instance, while increasing from 20.5 millimeters to 26.2 millimeters, decreases, relatively to the basilar length, from 116 to 100 per cent.

Most of the other measurements follow the above general pattern, but there are a few significant exceptions to this rule. The interorbital constriction, for instance, decreases in relative width from youth to age, but actually it remains nearly constant. The length of the diastema, and the post-palatal length, increase both actually and relatively, indicating that most of the growth in the ventral portion of the skull occurs in these two parts. In the palatal region there is but little growth, as shown by the relative decrease in length of the upper tooth rows.

Of bones on the dorsal side of the skull, the nasals increase most in length. Thus it is seen that most of the growth occurs anteriorly, with an actually and relatively

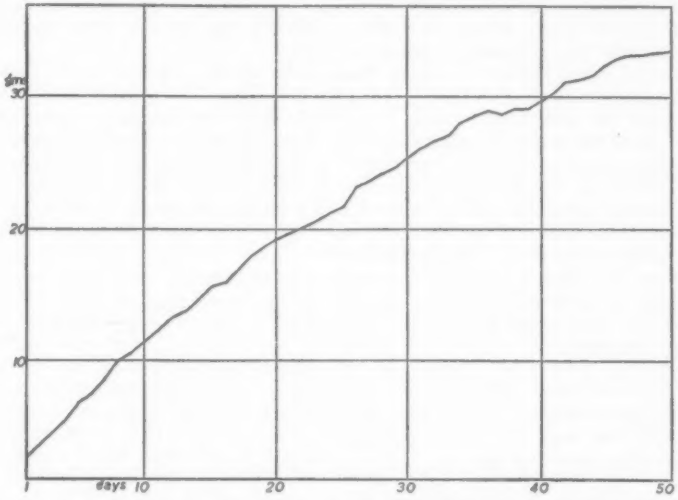

FIG. 1. Curve illustrating increase in weight in *Microtus californicus californicus* from birth to age of fifty days; average of five litters.

greater increase in the length of the rostrum than in the length of the posterior portions of the skull. These same parts of the skull are the ones which Allen (1894) in *Neotoma micropus* and Hall (1926) in *Citellus beecheyi* found to increase most during postnatal growth.

PIGMENTATION AND PELAGE

Meadow mice, when born, are blind, deaf, and, with the exception of the vibrissae, without external trace of hair or dermal pigment. The mice are uniformly pink in color; the beating heart and the outline of the liver are plainly visible through the body wall. The skin is relatively loose, and it is folded accordion-like, for the full length of the body.

Dermal pigment is not present until eight hours after birth, at which time there appears on top of the head a slate-blue (Ridgway, 1912) area with ill-defined borders.

This pigmentation spreads rapidly over the whole dorsal side of the head and posteriorly along the back. Thirty-six hours after birth the pigment covers more than half the back anteriorly. In the meantime the color of the top of the head has become progressively darker until it approaches dusky slate-blue. At about this time the hair appears as a short down, first on the top of the head, and later on the anterior part of the back, finally covering the whole body. This gradual spreading from the head posteriorly is what one would expect on the basis of Child's (1915, pp. 66, 67) law of axial gradients.

Seventy-two hours after birth the color has extended so that it covers completely the back, and the dorsal side of the tail, with a definite line of demarcation separating the dark-colored upperparts from the light-colored underparts. The pigmentation at this time is a uniform dusky slate-blue hue and is beginning to appear all around the tarsus and on the antipalmar face of the carpus.

The hair on the back and head has reached an average length of two millimeters at seventy-two hours, though not until the fifth day does the hair attain this length over the entire body exclusive of the tail and feet.

The pigment in the skin begins to disappear on the ninth or tenth day. It finally disappears completely, leaving the skin a light flesh color. The pelage is unmistakably juvenal at this time; and, so far as I am able to determine, this juvenal pelage is retained up to the end of the third week after birth. Presently a dark pigment appears all over the inside of the skin; examination of the outside of the skin reveals that hair is coming in all over the body. This growth results in the post-juvenal pelage. The dark pigment in the skin then becomes reduced in extent from the sides toward the back. In a specimen 35 days of age it is reduced to a dark dorsal streak which appears to be the remnant of the post-juvenal molt pigment.

About the eighth week the adult pelage begins to grow and, starting on the belly, to extend up the sides, thus finally reaching the mid-dorsal line. Anteriorly the molt "line" (indicated by the pigmentation of the skin) moves forward across the shoulders to the head region.

In summary, there is a sequence of three distinct pelages: The juvenal, not complete until the fifth day; this gives way to the post-juvenal pelage during the third week; it is in turn replaced by the adult pelage about the eighth or ninth week after birth. The molt lines begin along the mid-ventral area and proceed up the sides until they have reached the mid-dorsal line. There are no definite molt lines visible superficially on the pelage, but the pigmented areas on the inside of the skin clearly indicate the points at which new hair is being grown.

In adult mice, both captive and wild-taken individuals, the molts are apparently irregular, spreading out from isolated loci on the skin, in this respect differing from the post-juvenal molt.

LITERATURE CITED

Allen, J. A. 1894. Cranial variations in *Neotoma micropus* due to growth and individual differentiation. Bull. Am. Mus. Nat. Hist., vol. 6, pp. 233–246, 1 pl.

Bailey, Vernon 1924. Breeding, feeding, and other life habits of meadow mice (*Microtus*). Jour. Agr. Research, vol. 27, pp. 523–535, pls. 1–3.

Child, C. M. 1915. Individuality in organisms. Univ. Chicago Press, Chicago, Ill. pp. i–x, 1–213, figs. 1–102.

Davis, D. H. S. 1933. Rhythmic activity in the short-tailed vole, *Microtus*. Journ. Animal Ecol., vol. 2, pp. 232–238, 2 figs., 3 tables in text.

Grinnell, J. 1908. The biota of the San Bernardino Mountains. Univ. California Publ. Zool., vol. 5, pp. 1–170, pls. 1–24.

Hall, E. R. 1926. Changes during growth in the skull of the rodent *Otospermophilus*

grammurus beecheyi. Univ. California Publ. Zool., vol. 21, pp. 355–404, 43 figs. in text.

HOWELL, A. B. 1924. Individual and age variation in *Microtus montanus yosemite*. Journ. Agric. Research, vol. 28, pp. 977–1015, 25 figs., 1 pl., 4 tables in text.

RIDGWAY, R. 1912. Color standards and color nomenclature. Published by the author, Washington, D. C. 53 colored pls., 1115 named colors.

SELLE, R. M. 1928. *Microtus californicus* in captivity. Journ. Mamm., vol. 9, pp. 93–98, 3 tables in text.

SUMNER, F. B. 1932. Genetic, distributional, and evolutionary studies of the subspecies of deer mice (*Peromyscus*). Bibliographia Genetica, vol. 9, pp. 1–106, 24 figs. in text.

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THE MAMMALS OF A FLORIDA HAMMOCK

BY W. FRANK BLAIR

The work presented here has been done to determine the ecological relationships of the mammals of a Florida hammock region and some of the factors influencing and limiting their distribution in the region.

The material was gathered by trapping operations and observations in the Biology Station grounds of the University of Florida between October 29, 1934 and January 10, 1935.

The Biology Station is located on the western shore of Newnan's Lake, five miles east of Gainesville. The station grounds occupy a strip along the lake front about 200 yards long and reaching back about 150 yards from the shore line. A shallow swamp bounds the area on the north, and part of it is included in the grounds. The area shows no signs of lumbering or recent fires, and is probably very nearly in a natural condition.

The grounds include high hammock characterized by *Magnolia grandiflora*, a considerable extent of deciduous forest, shallow swamp characterized by *Nyssa sylvatica*, *Taxodium distichum*, and *Liquidambar styraciflua*, and lake front occupied by *Taxodium distichum*.

A scale map was made of the grounds showing the extent of the plant communities, and on this has been entered the exact spot at which each mammal was taken or observed.

The most significant facts observed were the striking scarcity of individuals among the mammal population and the marked distribution of the smaller forms in relation to cover.

I am indebted to Dr. H. B. Sherman for the use of unpublished notes on *Nycticeius humeralis* and *Pipistrellus subflavus subflavus*, and for access to his collection of Florida mammals. I am also indebted to Dr. H. H. T. Jackson for verifying the identification of shrews belonging to the genera *Cryptotis* and *Blarina*.

NUMBERS OF MAMMALS

The scarcity of individuals is one of the most remarkable features that one finds in trapping small mammals in this region. There is no dearth of species, as 17 forms were recorded from the small area under consideration. On the other hand, only 37 individuals were taken in 1338 trap-nights.

A great abundance of predatory enemies is probably the greatest factor in limiting the numbers of small mammals. Owls, both the barred owl and great horned owl, are numerous. As many as four individuals have been heard calling at the same time in the station grounds, but it is probable that many more are residents of this area.

Bald eagles have been seen on several occasions soaring over the region, as have red-tailed and red-shouldered hawks.

Snakes are numerous. Six black snakes, *Coluber constrictor constrictor*, and two chicken snakes, *Elaphe quadrivittata*, have been captured in the area, and two coral snakes, *Micrurus fulvius*, were seen.

Another possible factor might be ants. Logs, rotting stumps, and dead trees are all inhabited by large numbers of ants. These insects by so completely occupying habitats that are normally occupied by small mammals probably limit to a considerable extent the number of these animals that the region will support.

The wildcat, *Lynx rufus floridanus*, probably keeps many of the smaller mammals, especially rabbits, in check.

Gray squirrels, flying squirrels, and bats, being unexposed for the most part to the dangers that surround the mainly terrestrial forms, are relatively abundant.

DISTRIBUTION OF MAMMALS

Cover appears to be the chief factor in the distribution of shrews and of *Peromyscus gossypinus gossypinus*. None were taken on the barren floor of the magnolia forest, and the region of greatest concentration of these forms was definitely the brier complexes, which offer the best cover.

The marsh rabbit, *Sylvilagus palustris paludicola*, seeks the cover of the briers by day but ranges over the entire area during the night.

Gray squirrels and flying squirrels find protection in the large, evergreen leaves of the magnolia and feed on its fruits.

Bats concentrate on the lake front, probably because of the greater numbers of insects to be found there. The larger mammals probably range over the entire region.

MAMMAL HABITATS

Magnolia Climax Forest.—*Magnolia grandiflora* dominates the area. There are many large trees of this species, some of which reach a diameter of as much as 30 inches. There are a few hollies, *Ilex opaca*, and hackberries, *Celtis mississippiensis*. The forest floor is very bare and park-like, there being no undershrubs except a few scattered French mulberries, *Callicarpa americana*. There is a carpet of fallen leaves on the ground, but few herbaceous plants grow here.

This bare area offers almost no cover for the smaller mammals, and none but the larger species such as the skunk, opossum, and marsh rabbit dare venture into this part of the region. On the other hand, the thick foliage of the magnolia furnishes excellent protection for the arboreal gray squirrels and flying squirrels.

List of Species

Didelphis virginiana pigra
Scalopus aquaticus australis
Mephitis elongata
Lynx rufus floridanus
Sciurus carolinensis carolinensis
Glaucomys volans querceti
Sylvilagus palustris paludicola

Deciduous Forest and Weed-Grown Areas.—A wide variety of small trees and numerous undershrubs characterize this area. *Carpinus caroliniana*, *Carya alba* and *Quercus nigra* form the bulk of the tree population. *Callicarpa americana*, several species of *Smilax*, *Asimina triloba*, and the seedlings of *Quercus nigra* and *Carya alba* form undergrowth of varying density in most of the region. In the more open spots not dominated by the larger trees, weeds have invaded the region and form good mammal cover.

In one area not dominated by trees, blackberry briers (*Rubus* sp.) have formed a dense complex of tangled and interlaced vines that is almost impenetrable except to small mammals.

There is a growth of loblolly pine (*Pinus taeda*) occupying about 200 square feet in the highest, driest part of the deciduous forest. Six pines, varying from six to 20 inches in trunk diameter grow here. There is a thick layer of pine needles on the ground.

List of Species

Didelphis virginiana pigra
Scalopus aquaticus australis
Cryptotis floridana
Blarina brevicauda carolinensis
Mephitis elongata
Lynx rufus floridanus
Sciurus carolinensis carolinensis
Glaucomys volans querceti
Peromyscus gossypinus gossypinus
Neotoma floridana floridana
Sylvilagus palustris paludicola

Lake Border and Shallow Swamp.—The lake is bordered by a strip of cypress (*Taxodium distichum*) and oak (*Quercus nigra*), extending from the tree line, which is sometimes as much as 20 feet out in the lake, to the edge of the magnolia forest. Cypress knees are very characteristic of the area and they take up a great deal of the ground space. There are no undershrubs, and the only herb growing here is *Centella repanda*, a low-growing, succulent plant favored as food by the marsh rabbit. Water hyacinths (*Piaropus crassipes*) cover the water in this area.

In the swamp, *Taxodium distichum*, *Liquidambar styraciflua*, and *Nyssa sylvatica* are the most important trees. There are numerous seedlings of *Fraxinus caroliniana* and some button-bushes, *Cephalanthus occidentalis*. The surface of the water is covered with duckweed (*Lemna perpusilla*) and here and there float bonnets, *Pistia stratiotes*. The bases of many of the trees protrude as small hummocks.

List of Species

Didelphis virginiana pigra
Myotis austroriparius
Pipistrellus subflavus subflavus
Nycteris seminola
Nycticeius humeralis
Tadarida cynocephala
Mephitis elongata
Lynx rufus floridanus
Sciurus carolinensis carolinensis
Sylvilagus palustris paludicola

Grassy Swamp Border.—All of the trees in this narrow strip lying along the margin of the swamp have been felled by wind and flood waters. They lie parallel to the water line, some in the swamp and some occupying an area about 30 feet wide along the shore. There is a heavy growth of grasses, and in many places patches of dead grass have been leveled by water to form good cover for shrews. The soil is rich in organic matter and contains a great deal of moisture.

List of Species

Didelphis virginiana pigra
Sorex longirostris
Cryptotis floridana
Blarina brevicauda carolinensis
Mephitis elongata
Lynx rufus floridanus
Peromyscus gossypinus gossypinus
Sylvilagus palustris paludicola

ANNOTATED LIST OF SPECIES

Didelphis virginiana pigra Bangs.—An opossum was captured on December 6, 1934, in a steel trap baited with the body of a skunk nailed to a magnolia tree. Two grown opossums were captured back of the station building in the autumn of 1933 by J. D. Kilby. The animals were prowling about the back yard and were easily captured. It is probable that this species ranges over the entire area.

Scalopus aquaticus australis (Chapman).—Moles are found in the deciduous forest and open areas and in the magnolia forest. They are numerous in these habitats, and their tunnels may be seen in all parts of them.

Sorex longirostris Bachman.—A single specimen of this rare shrew was taken in a snap trap baited with rolled oats and peanut butter on the night of November 18, 1934. Specimens of *Blarina* and *Cryptotis* were taken in the same spot on other nights. The trap was set under a fallen log that rested about 18 inches from the ground in the area bordering the swamp. On one side of the log there was a mat of dead grass beaten down by water and honeycombed beneath with the runways of shrews. On the other side there was green grass growing in a few inches of water.

I believe this is the second record of this species from Florida, the other specimen having been taken in 1927 by Dr. H. B. Sherman from the same hammock but outside the area covered in this survey (Sherman, 1928, Journ. Mammalogy, vol. 9, no. 2, p. 148).

Cryptotis floridana (Merriam).—Ten specimens of this species were taken in 1338 trap nights. Four were caught in the *Pinus taeda* society, three were captured along the swamp border, and three came from the blackberry briers.

The greatest concentration of this species seems to be in the blackberry brier complex, as the three specimens taken there represented only 100 trap nights compared to 1238 for the other areas. Adequate cover provided by the pine needles in the *Pinus taeda* society, by the dead grass along the border of the swamp, and by the briers and weeds of the brier complex seems to be one of the chief requisites of this species.

Blarina brevicauda carolinensis (Bachman).—This species appears to be less common than *Cryptotis* in this area. It is confined to the swamp border and blackberry briers. Four specimens were taken along the swamp, and two were captured in the briers.

Patches of dead grass beaten down by rain and water along the swamp have numerous small runways beneath them which are probably used by both *Blarina* and *Cryptotis*.

Myotis austroriparius (Rhoads).—A single specimen of this bat was shot on December 23, 1934. It was taken on the lake front but probably flies over the entire area.

Pipistrellus subflavus subflavus (F. Cuvier).—Five specimens of the pipistrelle were shot over the lake by Dr. H. B. Sherman between May 28, 1927 and June 3 of the same year.

Nycteris seminola (Rhoads).—Four specimens of the seminole bat were taken on the lake front and swamp. Many others were identified by their direct, not-fluttery flight, and this is probably the most common bat in this particular area.

Nycticeius humeralis (Rafinesque).—Three bats of this species were shot over the lake front by Dr. H. B. Sherman between May 30, 1927 and July 11, 1934.

Tadarida cynocephala (Le Conte).—A male and female of this species were shot flying over the lake front on the evening of December 24, 1934.

Mephitis elongata Bangs.—A skunk was taken in a steel trap set at the base of a magnolia tree on the night of December 4, 1934. A dead and somewhat decayed rabbit was used as bait. This species probably ranges over the entire area.

Lynx rufus floridanus (Rafinesque).—A large wildcat was seen in the area bordering the lake by G. Van Hyning in 1933. This species probably ranges over the entire area.

Sciurus carolinensis carolinensis Gmelin.—Gray squirrels are among the most common mammals of this area. They are largely confined to the magnolia forest. The

broad, evergreen leaves of the magnolia afford them excellent hiding places, and in the autumn the magnolia fruits constitute the squirrel's chief food.

Seven gray squirrels were seen in an area about 50 feet square late in the afternoon of December 17, 1934. Four were hopping about in the magnolias, pausing now and then to gnaw at a magnolia burr in search of the red, pungent seeds. Three were moving about on the ground. One ran about for several minutes beneath a haw (*Crataegus* sp.), picking up the fallen fruits. Another worried a thick-shelled mockernut for a minute or two and evidently gave it up as a bad job. The sound of the squirrel's teeth as it gnawed at the nut was audible 40 feet away.

Three of the squirrels scolded loudly from their respective trees. One in a small tree several yards away scolded first. The noise made was a short chirring followed immediately by a louder, more raucous, penetrating half-scream repeated several times. After the first had been silent for a few moments one very close to me ran chattering to the top of a magnolia and repeated the same performance. In a few moments it was repeated by another animal several yards away and also in a magnolia.

From September to December the magnolia fruits are undoubtedly an important item of food for the gray squirrels. The burrs are pulled off the tree, stripped of their berries, and dropped to the ground.

When the supply of berries has been exhausted late in the season the animals descend to the ground and dissect the woody burrs, evidently finding some portion of them edible.

Gray squirrels also feed on the acorns of the water oak (*Quercus nigra*) in the fall. One was seen in a mass of *Smilax* and was possibly feeding on the berries of that vine. Two squirrels were seen in cypress trees along the lake front. Fruits of the mockernut, *Carya alba*, are avidly eaten.

They sometimes go into the barren, deciduous trees of the swamp where on two occasions they were seen feeding on the berries of the tupelo, *Nyssa sylvatica*.

There are probably between 25 and 50 gray squirrels in this area, and most of them spend the greater part of their time in the magnolia forest.

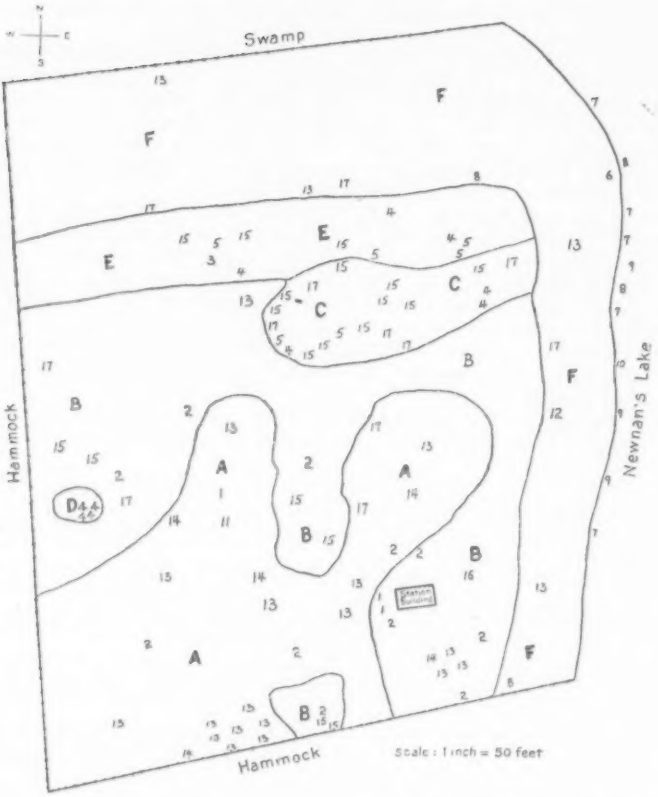
Glaucomys volans querceti (Bangs).—Flying squirrels are common and like the gray squirrels are largely restricted to the magnolia forest. One specimen was taken in a snap trap at the base of a magnolia on November 9, 1934.

The presence of flying squirrels may be easily detected by going into the woods at night and imitating the scream and hoot of the great horned owl. The flying squirrels in nearby trees become alarmed and may be located by their frightened squeaks. They are numerous but probably less so than the gray squirrels.

Peromyscus gossypinus gossypinus (Le Conte).—This species illustrates better than any other the distribution of the smaller mammals in relation to cover in this area. Of 19 individuals taken in 1338 trap nights none were caught on the bare ground of the magnolia forest where undercover is almost totally lacking or from the cypress belt bordering the lake where a similar condition exists. Three were taken on the border of the swamp where fallen trees, grasses, and weeds provide the same protection that they do for shrews.

Six were captured in the deciduous forest. All of these were taken in or near cover of some sort. One was captured beneath the protecting leaves of a young cabbage palm, *Sabal palmetto*. The others were taken in weed grown areas.

As would be expected, cover is the chief factor in determining where this species lives; the greatest concentration of mice was found to occur in the dense, tangled blackberry brier complex. In this relatively small area 10 mice were taken in 100 trap nights, compared to 9 taken in 1238 trap nights in the remainder of the station grounds. Two of those taken in the briers were adult males, two were adult females and the other six were immature.



BIOTIC DIVISIONS

A. Magnolia Climax forest
B. Deciduous forest and weedy areas
C. Subdominant *Rubus* society in deciduous forest
D. *Pinus taeda* society
E. Grassy swamp border
F. Swamp and lake front

POINTS AT WHICH MAMMALS WERE TAKEN OR OBSERVED

1. *Didelphis virginiana pigra*
2. *Scalopus aquaticus australis*
3. *Sorex longirostris*
4. *Cryptotis floridana*
5. *Blarina brevicauda carolinensis*
6. *Myotis austroriparius*
7. *Pipistrellus subflavus subflavus*
8. *Nycteris seminola*
9. *Nycticeius humeralis*
10. *Tadarida cynocephala*
11. *Mephitis elongata*
12. *Lynx rufus floridanus*
13. *Sciurus carolinensis carolinensis*
14. *Glaucomys volans querceti*
15. *Peromyscus gossypinus gossypinus*
16. *Neotoma floridana floridana*
17. *Sylvilagus palustris paludicola*

Neotoma floridana floridana (Ord).—A single specimen of the wood rat was trapped at the base of a bay (*Magnolia glauca*) on October 30, 1934. The trunk of the tree was inclined at an angle of about 45 degrees, and there were several holes in the rotting heart wood. A week later a large coral snake was discovered in the punky heart wood.

Concentrated trapping in all parts of the grounds failed to procure other specimens, and it is probable that the wood rat is rather scarce in this area.

Sylvilagus palustris paludicola (Miller and Bangs).—Repeated observations over a period of four months show that there are two marsh rabbits ranging over this area. No other rabbits have been observed, and the two seen, a male and a female, have apparently remained in the region during this time.

One was captured in a box trap in the brier complex on October 23, 1934. It was marked and released, and on October 25 the other was captured and marked. Number two was recaptured on October 28 and again released. Number one was retaken on October 29 and again on November 19. Both rabbits have often been observed since then in the brier complex. All of the captures except one were made in the briers, and the other was made in a fallen tree top in the deciduous forest.

Neither of the two individuals has been taken in extensive trapping outside of the station grounds, and it is probable that the home range of this species in a hammock of this type is confined to an area not much larger than that covered in this survey.

The rabbits range into all parts of the area. Fecal pellets have been found in the swamp, magnolia forest, deciduous forest, and cypress lake border. Fresh pellets have been found to contain seeds of the tupelo. A low succulent herb, *Centella repanda*, growing along the lake and swamp borders, shows evidence of grazing by rabbits. In captivity *Smilax* sp., *Rubus* sp., and *Centella* are seemingly preferred to all other foods.

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FORMOSAN MAMMALS PRESERVED IN THE COLLECTION OF MARQUIS YAMASHINA

By Nagamichi Kuroda

After completing the zoological exploration of the Korean Peninsula, Marquis Yamashina continued his collecting on the island of Formosa, where H. Orii worked from 1932 to the spring of 1933, bringing back a fine series of well prepared skins now in the Marquis's collection. Marquis Yamashina has been very generous in offering me all the mammal skins for identification and in granting me permission to publish the results.

I have examined the specimens carefully and have referred them to 33 species and subspecies, including some forms hitherto undescribed. The genus *Anourosorex* is a very remarkable addition to the fauna of Formosa.

Family SUIDAE

Sus leucomystax taivanus (Swinhoe)

Japanese: Taiwan-inoshishi

One juvenile male; Suiriko, Taichu-siu, central Formosa; February 9, 1933.

Remarks.—This is a young male with the back and sides of body mixed with black

and golden buff hairs; whiskers and throat with white hairs; mane-bristles black with gray tips, measuring about 100 mm. The iris is "vandyke brown" (H. Orii).

Measurements (in the flesh).—Head and body, 930 mm.; tail, 135; hind foot, 200; ear without hairs, 80.

Skull.—Occipito-premaxillary length, 266 mm.; condylo-basal length, 252.

Family CERVIDAE

Muntiacus reevesii micrurus (Selater)

Japanese: Kyon

One adult male; Tainan, south Formosa; January 11, 1933.

One adult female; Suiriko, Taichu-siu, central Formosa; February 5, 1933.

Remarks.—The male is apparently larger than the female. The iris is "clove brown" (H. Orii).

Measurements (in the flesh).—Male and female, respectively: Head and body, 645, 475 mm.; tail, 100, 74; hind foot, 140 (with hoofs), 120 (without hoofs); ear, 73, 55.

Skull.—Male and female, respectively: Condylobasal length, 134.5, 108 mm.; zygomatic breadth, 66, 52.5. Antlers lost.

Family MUSTELIDAE

Charronia flavigula xanthospila (Swinhoe)

Japanese: Kieri-ten

One old female; Taiheizan, Taihoku-siu, 7650 feet, northern Formosa; October 16, 1932.

Remarks.—The iris is "vandyke brown" (H. Orii).

Measurements (in the flesh).—Head and body, 445 mm.; tail, 350; hind foot, 82; ear, 40.

Skull.—Greatest length, including incisors, 91.5 mm.; basilar length, 81; zygomatic breadth, 54.

Mustela sibirica taivana Thomas

Japanese: Kuro-itachi

Two males, one female (all in summer pelage); Taiheizan, Taihoku-siu, 5500–6800 feet, northern Formosa; September 26–October 9, 1932.

Five males (all in winter pelage); Arisan, central Formosa; April 6–27, 1933.

Remarks.—The iris is "slate colored" (H. Orii). In the summer pelage, the upper and underparts, including tail, are very dark blackish brown in both sexes, like a young male in my collection, and with less bushy tail. In the winter pelage, the upperparts become dark brown, less blackish or dark yellowish brown in the oldest male, and the underparts are much lighter, nearly yellowish brown in tone. These seasonal changes of coloration are observable in a series of the Japanese *Mustela itatsi* in my collection, though the Formosan mink is darker in color even than the summer pelage of the Japanese form.

The white throat patch varies from a very small spot, a narrow longitudinal patch, or a cross bar, to a very large round spot. In some specimens it is entirely absent.

The Formosan mink is found only on the higher mountains and not on the plains.

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
44	Taiheizan	♂	335	198	58	27
46	Taiheizan	♂	335	210	60	22
61	Taiheizan	♀	251	154	48	23
150	Arisan	♂	320	210	60	26
154	Arisan	♂	325	198	61	27
174	Arisan	♂	335	215	61	25
175	Arisan	♂	335	222	60	25
176	Arisan	♂	323	208	59	24

Skull.—Two males and a female, respectively: Greatest length, 60, 63.5, and 53.5 mm.; basilar length, 55, 57, and 49; zygomatic breadth, 31.1, 34, and 27.

The skull of a young male in my collection from Arisan, collected in September, 1918, measures: Greatest length, 64.5 mm.; basilar length, 58; zygomatic breadth, 35. The braincase is much broader and rounder in shape than that of old males in the Yamashina collection.

Family VIVERRIDAE

Paguma larvata larvata (Temminck)

Japanese: Hakubishin

One juvenile male; Botel Tabago or Kôtôshô, near Formosa; July 20, 1932.

Remarks.—The iris is "burnt umber" (H. Orii). Mr. Orii failed to secure the animal in Formosa proper but he collected the above young male on the Botel Tabago, whence several adult skulls were examined by me; these do not differ from the Formosan examples.

I use here the generic name *Paguma* instead of *Paradoxurus*; the former seems to me to be separable from the latter genus, and Howell also used *Paguma* for this species.

Family FELIDAE

Felis bengalensis chinensis Gray × **Felis catus** Linnaeus

One adult male; Suiriko, Taichu-siu, central Formosa; February 13, 1933.

One adult male; Tamsui, northern Formosa; March 15, 1933.

Remarks.—The iris is "buff yellow" or "buff orange" (H. Orii). In the male from Suiriko (no. 113) the general color of the back is grayish with dusky cross lines, and the underparts are spotted with blackish. In the male from Tamsui (no. 121) the back is washed with brownish, with dusky cross lines, and the underparts are nearly unspotted. Tail with seven or eight blackish rings.

From the above characters, it is clear that the two specimens shot by Orii in Formosa are not the Chinese tiger-cat, *Felis bengalensis chinensis*. I believe them to be domesticated cats which have run wild or hybrids between *Felis bengalensis chinensis* and the domestic cat, *Felis catus*. I have a skin of a wild taken specimen from Tsushima, Japan, whose coloration and markings are like those of the Suiriko specimen. From the island of Tsushima we have also obtained *Felis euptilura microtis* Milne-Edwards, which has now become very rare.

Measurements (in the flesh).—Two males, respectively: Head and body, 460, 420 mm.; tail, 295, 235; hind foot, 118, 107; ear, 56, 55.

Skull.—Two males, respectively: Greatest length, 90.5, 93 mm.; basilar length, 74, 74.5; zygomatic breadth, 64, 67.

Family SCIURIDAE

Callosciurus erythraeus roberti (Bonhote)

Japanese: Kuribara-risu

Two males, two females; Taiheizan, Taihoku-siu, northern Formosa; October 4–19, 1932.

Remarks.—The iris is "slate colored" (H. Orii). This is the northern representative of the *erythraeus* group in Formosa. A distinct rusty wash on back and tail; coloration of no. 75 is typical; underparts bright chestnut throughout; upper surface of hands and feet indistinctly grizzled.

Measurements (in the flesh).—Two males (nos. 49, 71) and two females (nos. 48, 75), respectively: Head and body, 190, 188, 218, 200 mm.; tail, 193, 190, 180, 202; hind foot, 50, 51, 51, 52; ear, 21, 21, 22, 23.

Skull.—Greatest length, 52–54.5 mm.; basilar length, 41.5–45.5; zygomatic breadth, 29–32.

Callosciurus erythraeus centralis (Bonhote)

Japanese: Sujihara-risu

One female; Suiriko, Taichu-siu, central Formosa; February 17, 1933.

Three males, three females, two subadult females, one juvenile female; Arisan, 7500–8000 feet, central Formosa; April 10–May 7, 1933.

Remarks.—The iris is "slate colored" (H. Orii). Usually the rusty wash on hairs of back and tail is less conspicuous than in *roberti*, but one adult female from Arisan has a rusty wash on the back, similar to the latter. The upper surface of the hands and feet is usually pale, with indistinct pencilling.

From the above series I can state that adults of *centralis* have three different color types on the ventral surface of the body. The first is chestnut throughout, like *roberti*, but differs in having no distinct rusty wash on the back; the second is chestnut with a distinct, more or less conspicuous, longitudinal median grayish line on the ventral surface (this example is the typical *centralis* of Bonhote); in the third, the greater part of the ventral surface is dirty yellowish, with dusky chestnut patches on the sides of the body, especially at the inner surface of hands and feet. The third type is rare in the collection, observed only in the skins from Arisan (nos. 160, ♂ad.; 184, ♂ad.). These rare examples most resemble Bonhote's *thaiwanensis* from southern Formosa; but they may be separated from the latter series before me by the general tone of color on the ventral surface, being dirty yellowish instead of grayish or grayish yellow, and by the fulvous instead of grayish white tips on the tail hairs. The longitudinal ventral line is noticeably variable, sometimes distinct, sometimes narrow, or entirely wanting.

I have two very young examples from Hori, in central Formosa, one of which has its underparts yellowish chestnut, somewhat washed with grayish, with a perceptible median line like the adult, while the other one has the underparts entirely dusky vinous chestnut throughout, like *roberti*. From this fact it is almost beyond doubt that the young ones of *centralis* also vary in their color and markings on the under side, quite like the variations noted in the series of the adults.

This form is found only in the central mountainous parts of Formosa, reaching 10,000 feet on Mt. Morrison. The measurements of the adults are not perceptibly different from those of *C. erythraeus roberti*.

Measurements.—Head and body, 204–225 mm.; tail, 167–185; hind foot, 48–53; ear, 20.5–23. The tail length apparently averages slightly shorter than in *C. erythraeus roberti* but this may not be a constant character.

Callosciurus erythraeus nigridorsalis, subsp. nov.

Japanese: Seguro-sujihara-risu

Six males, four females; Riran, Taito, southeastern Formosa; June 21–August 1, 1932.

One male, one female; Daibusan, Takao-siu, 6000 feet, southern Formosa; May 18, 28, 1933.

Type.—Adult female; Riran, Taito, southeastern Formosa; August 1, 1932; no. 22, collection Marquis Yamashina; collector, H. Orii.

Diagnosis.—Very similar to *C. erythraeus centralis* of central Formosa, but readily distinguishable from it by the dorsal area, which is clothed with glossy black hairs, making this part entirely blackish; upper surface of hands and feet also pure black, nearly without the pale grizzling seen in *roberti*, *centralis*, and *thaiwanensis*.

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
11	Riran	♂	215	153	48	19
12	Riran	♂	233	198	50	21
13	Riran	♂	223	200	52	21
14	Riran	♂	224	198	51	20
16	Riran	♀	225	198	57	22
18	Riran	♀	202	197	47	21
19	Riran	♂	230	190	52	24
20	Riran	♂	215	178	51	23
21	Riran	♀	207	189	51	21.5
22 (type)	Riran	♀	212	180	50	24
185	Daibusan	♂	220	202	52	21
194	Daibusan	♀	228	172	54	23

Skull (type).—Greatest length, 55.5 mm.; basilar length, 46.5; zygomatic breadth, 33.5; length of nasals, 16.

Remarks.—The measurements of the body and of the skull are not appreciably different from those of allied forms. The color of the iris is "slate" in the male and "slaty brown" in the female (H. Orii). This form has also the same variation in the color and markings of the ventral surface that is seen in *C. erythraeus centralis*. Most of the specimens have a longitudinal line on the chestnut colored underside, but this is variable. Two (nos. 16 and 18) lack this line, while it is very conspicuous in three others (nos. 13, 19, and 20). In still others an intermediate condition in the development of this line exists. In the type specimen this line is faintly indicated. An adult female from Daibusan (no. 194) is peculiar in having dark grayish yellow underparts with chestnut patches at the inner side of the limbs.

The black backed form inhabits the southeastern parts of Formosa as well as the region around Daibusan, southern Formosa, which seems to be the southern limit of its distribution.

Callosciurus erythraeus thaiwanensis (Bonhote)

Japanese: Takasago-risu

Four males, two females; Koshun, southern Formosa; May 19–31, 1932.

Remarks.—The characters of this subspecies are as follows: Back grayish yellow, with no rusty or black wash; rump, with a slight blackish wash; tail with grayish white instead of fulvous tips to the hairs. The underside of a typical example is entirely grayish, but this varies to grayish yellow with a small pale chestnut patch at inner sides of the limbs, like that which rarely occurs in examples of *C. erythraeus centralis* and *C. erythraeus nigridorsalis*. Upper side of hands and feet with slight, but evident pale grizzling. The iris is "clove brown" (H. Orii). The skull does not differ from those of allied races.

This race seems to be somewhat rarer than *C. erythraeus centralis*. It is found only in the southernmost parts of the island.

Measurements (in the flesh).—Head and body, 199–220 mm.; tail, 170–195; hind foot, 49–51; ear, 20–21.

Dremomys owstoni (Thomas)

Japanese: Ôston-risu

Two males, two females (all in summer pelage); Taiheizan, Taihoku-siu, 5500–6000 feet, northern Formosa; September 24–October 18, 1932.

Three males, four females (all in winter pelage); Arisan, 8300 feet, central Formosa; April 10–30, 1933.

Remarks.—All of the specimens have a buffy white spot behind the ear. The winter pelage remains until April, and these individuals have long glossy black hairs on the median dorsal line. Those in summer pelage (September and October) have lost the long black hairs on the back; the general coloration of the back is paler and the hairs are shorter. The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—Head and body, 176–195 mm.; tail, 120–173; hind foot, 44–53; ear, 18–25.

Skull.—Greatest length, 52.5–55.5 mm.; basilar length, 40.5–43.5.

Tamiops macclellandi formosanus (Bonhote)

Japanese: Taiwan-shimarisu

Two males (summer pelage), two juvenile females; Riran, Taito, southeastern Formosa; June 9–July 6, 1932.

One male and four females (all in summer pelage), one juvenile female; Taiheizan, Taihoku-siu, 7000 feet, northern Formosa; September 10–27, 1932.

Two males and three females (all in winter pelage), and one juvenile female; Arisan, central Formosa; April 2–20, 1933.

Remarks.—Specimens obtained in April and May are in winter pelage and those taken in June to September are in summer pelage. The winter specimens from Arisan have pale (buffy) and dark (brownish black) stripes on the back. These stripes are narrower and more obscured, and the mantle is grayer than in summer specimens. In the summer specimens from Taiheizan, north Formosa, and Riran, southeastern Formosa, the color is similar in tone, with the general tint of the dorsal area grayer, less rusty on the back, and the stripes broader and rather well defined. The iris is "slate or clove brown" (H. Orii).

Measurements (in the flesh).—Head and body, 114–134 mm.; tail, 97–112; hind foot, 26–34; ear, 12–14.5.

Skull.—Greatest length, 35–37.5 mm.; basilar length, 27.1–30.5; zygomatic breadth, 20–22.

Petaurista grandis (Swinhoe)

Japanese: Ô-akamusasabi

One female; Riran, Taito, southeastern Formosa; June 18, 1932.

One male; Suiriko, Taichu-siu, central Formosa; February 13, 1933.

Remarks.—This form is probably a race of *Petaurista petaurista*. The iris in the male is "seal brown"; in the female, "clove brown" (H. Orii).

Measurements (in the flesh).—Male and female, respectively: Head and body, 368, 385 mm.; tail, 402, 445; hind foot, 70, 69; ear, 41, 44.

Skull.—Male and female, respectively: Greatest length, 70, 69 mm.; basilar length, 56.5, mm. 57; zygomatic breadth, 44.5, 46.

Petaurista lena Thomas

Japanese: Kaojiro-musasabi

One female; Suiriko, Taichu-siu, central Formosa; February 21, 1933.

Remarks.—This is one of the rarest mammals in the mountains of Formosa. I have obtained another specimen of the same species from Hori in central Formosa. The iris is "clove brown" (H. Orii).

Measurements (in the flesh).—Head and body, 420 mm.; tail, 480; hind foot, 75; ear, 44.

Skull.—Greatest length, 71 mm.; basilar length, 58; zygomatic breadth, 47.5.

Family MURIDAE

Microtus kikuchii Kuroda

Japanese: Kikuchi-hatanezumi

Three males; Taiheizan, Taihoku-siu, 6300 feet, northern Formosa; September 17–October 20, 1932.

Remarks.—The type specimen is an adult female from Mt. Morrison, 10,000 feet above sea level, which is rather larger than the other specimens in the series. The measurements of the type are as follows: Head and body, 127 mm.; tail, 96.5; hind foot, 22.5.

This vole is rather rare, occuring only in the high mountains of Formosa, where the late Mr. Kikuchi obtained the type. Mr. Kano collected 7 specimens at Bunuruon, Mt. Takusha-taizan, at 10,000 feet altitude. The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—Head and body, 114–122 mm.; tail, 66–77; hind foot, 23–24; ear, 16–18.

Skull.—Greatest length, 29.5–32 mm.; basilar length, 25.5–28; zygomatic breadth, 16.1–17.5.

Apodemus semotus Thomas

Japanese: Taiwan-akanezumi

One male, five females, two juvenile males; Taiheizan, Taihoku-siu, 6000–7000 feet, northern Formosa; October 6–14, 1932.

Ten males; Arisan; central Formosa; April 1–8, 1933.

Remarks.—The juvenile specimen has its upperparts darker gray and less brownish; its underparts are mouse gray, with whitish tips to the hairs.

The specimens taken in April (winter pelage) are on the average slightly more brownish than those obtained in October (summer pelage still retained).

This species seems to be not uncommon in the high mountains of Formosa.

Measurements (in the flesh).—Head and body, 85–101 mm.; tail, 89–127; hind foot, 23–26; ear, 15–19.

Skull.—Greatest length, 26.1–28 mm.

Rattus rattus rattus (Linnaeus)

Japanese: Kuma-nezumi

One adult female; Botel Tabago or Kôtôshô, near Formosa; July 21, 1932.

Remarks.—This is the typical European black rat, with the usual slaty black color. It seems to be very rare on this island, as in Formosa. The iris is "slate colored" (H. Orii).

Rattus rattus[? **alexandrinus** (Geoffroy)]

Japanese: Ejiputo-nezumi

One male, one female; Riran, Taito, southeastern Formosa; July 10, August 1, 1932.

One old male; Botel Tabago, near Formosa; July 18, 1932.

One male, two females; Suiriko, Taichu-siu, central Formosa; November 17–27, 1932.

One male; Tainan, southwestern Formosa; December 27, 1932.

One juvenile male; Daibusan, Takao-siu, southern Formosa; May 27, 1933.

Two males; Tamsui, northern Formosa; March 16 and 19, 1933.

Remarks.—All of the above specimens have the dorsal area less brownish than in typical *alexandrinus*, most of them having bristly black hairs intermixed on the rump. The underparts are grayish, with gray bases to the hairs. These specimens are very different from the Japanese *alexandrinus* in color. I hesitate to identify them with this subspecies.

Measurements (in the flesh).—Head and body, 130–165 mm.; tail, 150–181; hind foot, 28–34; ear, 18–21.5.

Rattus rattus[? **rufescens** (Gray)]

Japanese: Akaguma-nezumi

Three males, five females, one juvenile male; Daibusan, Takao-siu, southern Formosa; May 25–29, 1933.

Remarks.—These specimens from Mt. Daibusan have dull rufous-tinged backs and buffy or grayish buff underparts. Some of them agree fairly well in color with the description of *rufescens* by Thomas (Proc. Zool. Soc. London, 1881, p. 534); but most of them seem to be rather larger. Moreover, I have compared them with a large series from Japan proper and the Riu Kiu islands and have come to the conclusion that the skins from the two last mentioned localities are decidedly brighter and have a stronger rufous wash on the back, and that the underparts are strongly washed with cinnamon color. The Daibusan skins are intermediate between the Japanese form and the so-called *alexandrinus* from Formosa, especially those from Riran, Suiriko, Tainan, etc. I have typical *alexandrinus* from Transvaal, South Africa, and Fayum in Egypt, which have very much darker gray underparts and nearly as reddish backs as in the Japanese examples, and are somewhat larger. These African specimens are nearly identical in color with three skins from Korea in the Marquis Yamashina's collection (see my Kor-

ean article). From the above facts, the occurrence of *rufescens* in Formosa seems to be certain and the occurrence of the true *alexandrinus* in Formosa seems to be very doubtful. Prof. Aoki in Formosa is now studying the changes of color in this species. He has just pointed out that most of the Formosan specimens should be called *rufescens* (Trans. Nat. Hist. Soc. Formosa, vol. 23, nos. 128–129, p. 387, December, 1933). The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—Head and body, 138–166 mm.; tail, 175–203; hind foot, 31–32; ear, 22–23.

Rattus coxinga (Swinhoe)

Japanese: Toge-nezumi

Two males; Suiriko, Taichu-siu, central Formosa; November 3, 1932 and February 8, 1933.

One male; Daibusan, Takao-siu, southern Formosa; May 26, 1933.

Remarks.—The specimen taken in May has the dorsal parts and sides of the body more washed with orange-ochraceous than those obtained in November and February. The iris is "slate colored" (H. Orii).

Swinhoe (Proc. Zool. Soc. London, 1864, pp. 185, 382) at first named this rat "*coninga*," but later corrected the spelling to *coxinga* (*op. cit.*, 1870, p. 636). Bonhote (Fasc. Malay. Zool., vol. 1, pp. 33, 36, 1903), however, changed it to "*coxingi*," an alteration not sanctioned by the International Code of Zoological Nomenclature.

Measurements (in the flesh).—Head and body, 173–192 mm.; tail, 216–249; hind foot, 36; ear, 22–25.

Skull.—Greatest length, 40–48.5 (old individual); basilar length, 32–38.5; zygomatic breadth, 20–21.

Rattus culturatus Thomas

Japanese: Niitaka-nezumi

Two males, three females, one juvenile female; Taiheizan, Taihoku-siu, 6000–7000 feet, northern Formosa; September 22–October 20, 1932.

Six males, five females; Arisan, central Formosa; April 1–4, 1933.

Remarks.—The winter pelage (April) is on an average slightly browner on the back and has a more creamy wash on the white belly than in the summer pelage (September and October). In some specimens (male, female, and juvenile), there is a grayish chest spot, which varies in length from 17 to 20 mm.; only five individuals in the collection entirely lack this spot. The white part of the upper side of the tail varies from 31.5 mm. in females to 89 mm. in males. On an old female it measured 112 mm., but on an average, the white part is longer in the older males than in females and in the young examples, in which it measures 26–66 mm. One of the young male specimens lacks it entirely.

The young specimens have their dorsal parts more grayish, without the brownish wash of adults; hairs very soft; ventral surface much whiter, less washed with creamy. The iris is "slate colored" (H. Orii).

This is the mountain-living rat, possibly a representative of the species *excelsior*, of the western China highlands, as Thomas suggested (Ann. & Mag. Nat. Hist., vol. 20, no. 8, p. 198, 1917).

Measurements (in the flesh, except juveniles).—Head and body, 128 mm. (subad.), 157 (old); tail, 185 (subad.), 226 (old); hind foot, 32–35; ear, 23–27.

Skull.—Greatest length, 38.5–41.5 mm.; basilar length, 28–32.5; zygomatic breadth, 16.9–18.5.

Rattus kagii (Kuraoka)

Japanese: Kagi-nezumi

1912. *M[us] kagii* Kuraoka, Journ. Nat. Hist. Soc. Taiwan, no. 6, p. 7. (*Nomen nudum*).

1912. *"M[us] kagii? N[esocia] nemorivaga"* Kuraoka, Journ. Nat. Hist. Soc. Taiwan, no. 6, p. 26. (Bokushi kyaku, Kagi District, central Formosa).

1926. *Rattus eloquens* Kishida, Dôbutsu Kyôzai no Kwagakuteki Kenkyu, 1925, p. 144. June, 1926. (southern Formosa.)

Four males, one female, two juvenile males; Suiriko, Taichu-siu, central Formosa; November 13–27, 1932.

Remarks.—This species may possibly be the same as *Bandicota nemorivaga* (Hodgson). The iris is "slate colored" (H. Orii). This large grayish brown rat is much larger and more robust in appearance than the Norway rat. The blackish brown dorsal hairs, especially on the rump, are much lengthened and are very bristly. Sometimes they reach a length of 36 mm. The underparts are grayish white with gray bases to the hairs; hands and feet covered with reddish brown hairs; ears rather short, not reaching to eyes when folded forward. Teeth very simple in structure, only slightly more complicated on the lower molars than in those of the true *Bandicota nemorivaga*. The difference in the teeth in these two species is shown in Kuraoka's plate. The young examples are grayer, especially on the sides of the body and the rump, with shorter bristly hairs.

Professor Aoki (Trans. Nat. Hist. Soc. Formosa, vol. 23, nos. 128, 129, pp. 387-388, December, 1933) has concluded that a paratype of *Rattus eloquens* can be matched among some young examples in a good series of *Bandicota nemorivaga*. It also seems to him that *Mus kagii* Kuraoka is not separable from *Bandicota nemorivaga*. I have compared the seven skins in Marquis Yamashina's collection, which are listed above, with one old specimen of *Bandicota nemorivaga* from Hori in central Formosa and have come to the conclusion that these skins are no doubt referable to Kuraoka's *Mus kagii*. Although Professor Aoki may be correct in uniting *kagii* and *eloquens* with *nemorivaga*, I still hesitate to accept this opinion as fully substantiated. I therefore continue to use the name *Rattus kagii* for the specimens collected by Orii.

Measurements (in the flesh).—

NUMBER	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
79	♂ juv.	165	143	40	26
80	♂ juv.	167	142	40	27
87	♂ ad.	197	178	41	28
89	♀ subad.	173	148	40	27
90	♂ ad.	178	160	43	27
92	♂ ad.	175	158	40	28
97	♂ ad.	189	186	45	26

The original specimen (♂), preserved in alcohol, was measured by Kuraoka as follows: Head and body, 210 mm.; tail, 180; hind foot, 41; ear, 25.

Kishida's *Rattus eloquens*, also preserved in alcohol, was measured by him as follows: Head and body, 173.5 mm.; tail, 175; hind foot, 43.2; ear, 25. These dimensions are quite similar to some of the specimens of the so-called *Rattus kagii* listed above.

Skull.—Greatest length, 45.5 (juv.)—50 mm. (ad.); basilar length, 38 (juv.)—43 (ad.); zygomatic breadth, 24 (juv.)—27 (ad.); length of nasals, 14.9 (subad.)—16.5 (ad.).

Mus musculus taiwanus Horikawa

Japanese: Taiwan-hatsukanezumi

1929. *Mus musculus taiwanus* Horikawa, Trans. Nat. Hist. Soc. Formosa, vol. 19, no. 100, p. 80 (Northern Formosa.)

Two males, two females; Suiriko, Taichu-siu, central Formosa; November 17, 1932, and February 28, 1933.

Two femles; Tamsui, northern Formosa; March 21, 1933.

Remarks. According to Horikawa this mouse is quite common and is found in houses. The iris is "slate colored" (H. Orii). The tail is longer than or rarely equal to the length of the head and body. The subadult female in the collection (no. 125) is darker on the back and underparts than the adults.

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
84	Suiriko	♂ ad.	73	89	16	13.5
85	Suiriko	♀ ad.	71	76	14.5	13
118	Suiriko	♂ ad.	67	75	15	12
119	Suiriko	♀ ad.	65	75	16	12
125	Tamsui	♀ subad.	68	68	15	11
126	Tamsui	♀ ad.	76	84	18	12

Skull.—Greatest length, 18.5–21 mm.; basilar length, 15–16.5; zygomatic breadth, 10–10.5; length of nasals, 6.5–7.1.

Family SORICIDAE

Soriculus fumidus Thomas

Japanese: Kemuri-togarinezumi

One male, three females; Arisan, 7800 feet, central Formosa; April 3–May 4, 1933.

Remarks.—The reddish brown tips of the teeth wear off to a great extent in old animals, and sometimes disappear entirely; but traces can generally be detected, as Blanford noted. The upperparts are smoky brown and the underparts are mouse gray, tinged with brownish. The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—Head and body, 62–70 mm.; tail, 41–54; hind foot, 11–15; ear, 7–8.

Skull.—Greatest length, 18.5–19 mm.; basilar length, 16–16.5; greatest breadth, 8.5–9.5.

Chodsigoa sodalis Thomas

Japanese: Arisan-togarinezumi

Three males, four females; Suiriko, Taichu-siu, central Formosa; September 15–26, 1932, and February 17, 1933.

One male; Tamsui, northern Formosa; March 21, 1933.

Remarks.—The upperparts are uniform gray in color and the underparts are lighter I can not find any difference in color between summer (September specimens) and winter

(February and March) pelages. The tail is shorter than head and body, with long bristly hairs as in *Crocidura*. The iris is "slate colored" (H. Orii).

This species was described by Thomas (Ann. & Mag. Nat. Hist., ser. 8, vol. 11, p. 217, February, 1913) from a skull obtained by Goodfellow on Mt. Arisan, 8000 feet, central Formosa. The external measurements and description of color of fur have not previously been published.

The teeth in this genus number 28, instead of 30, as in *Soriculus*. The tooth formula is as follows: i $\frac{3}{2}$, c $\frac{1}{1}$, pm $\frac{1}{1}$, m $\frac{3}{3}$ = 28. The minute upper premolar is lacking.

The specimens in Marquis Yamashina's collection have the teeth entirely white, not stained with reddish, although Thomas has stated of his type specimen: "pigmentation at a minimum, the tip of the first incisor and the extreme tip of the unicuspids and large premolar being but quite lightly marked with rufous." The species seems to be found on high mountains as well as in lower districts.

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT	EAR
			mm.	*mm.*	*mm.*	*mm.*
81	Suiriko	♀	76	44	14	7.5
82	Suiriko	♀	78	47	13	7
86	Suiriko	♂	75	53	13.5	7.5
91	Suiriko	♀	78	52	13	7
94	Suiriko	♀	76	52	13	7
95	Suiriko	♂	73	48	12	7
114	Suiriko	♂	75	52	14	9
124	Tamsui	♂	75	53	14	9

Skull.—Greatest length, 20–21 mm.; basilar length, 18–19; greatest breadth, 8.5–9.

Anourosorex squamipes yamashinai, subsp. nov.

Japanese: Mogura-jinezumi

Three males, two females, and two unsexed skins (all in summer pelage); Taiheizan, Taihoku-siu, 5500–6800 feet, northern Formosa; September 16–October 8, 1932.

Two males, three females (all in winter pelage); Arisan, 7800–8000 feet, central Formosa; April 25–May 4, 1933.

Type.—An adult female; Taiheizan, Taihoku-siu, 5500 feet, northern Formosa; October 7, 1932; no. 58, collection Marquis Yamashina; collector, H. Orii.

Diagnosis.—Similar to *Anourosorex squamipes*, but tail shorter (9–13 mm.), much shorter than the hind foot (14–17.5 mm.), and the palatal length only 10.5 mm. instead of 11.5–12.5 mm. (according to Howell).

Coloration.—Summer pelage: Fur rather coarse, dark slaty above; brownish rusty patch on rump, varying in size, mostly indistinct or wanting; underparts paler grayish. Winter pelage: Fur velvety, mouse gray above, paler gray below; the brownish rusty patch on rump more distinct than in the summer pelage. All the specimens have the rump hairs much elongated, forming an elevated tuft; fur with glistening hairs in some lights. Osgood (Publ. 312, Field Mus. Nat. Hist., Zool. ser., vol. 18, no. 10, p. 249, 1932) is quite right in stating as follows: "Usually they [colored hairs] are glistening with a mucilaginous exudation, or frequently matted together with it. The simulation of caked soil or other inorganic matter suggests that there is some connection with the burrowing habit, but examination of the hairs under a hand lens usually shows nothing on them except the above-mentioned exudate." The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—

NUMBER	LOCALITY	SEX	HEAD AND BODY	TAIL	HIND FOOT
36	Taiheizan	?	108	12	17.5
37	Taiheizan	?	88	10.5	16
40	Taiheizan	♀	105	12	16
52	Taiheizan	♂	87	10	15
57	Taiheizan	♂	95	10	16
58 (type)	Taiheizan	♀	107	11	16
60	Taiheizan	♂	105	11	16
173	Arisan	♀	95	13	15
177	Arisan	♂	95	11	16
180	Arisan	♂	100	12	14
181	Arisan	♀	97	9	14
182	Arisan	♀	96	9	14

Skull.—Type: Greatest length, including incisors, 26 mm.; superior margin of foramen magnum to tip of premaxilla, 25; condylobasal length, 25.9; basilar length, including incisors, 23.5; palatal length, 10.5; interorbital constriction, 6.1; mastoid width, 14; upper tooth row, 11.5; mandible, with incisors, 17; mandible, without incisors, 14.5; lower tooth row, 10.2.

Remarks.—The discovery of the genus *Anourosorex* in the high mountains of Formosa is an important addition to the mammal fauna of that island.

Family TALPIDAE

Mogera insularis (Swinhoe)

Japanese: Takasago-mogura

One unsexed skin; Riran, Taito, southeastern Formosa; July 6, 1932.

Measurements.—Head and body, 127 mm.; tail, 12; hind foot, 14.

Skull.—Greatest length, 30.5 mm.; basilar length, 27; greatest breadth, 14.5; index-number of skull, 442.

Thomas (Proc. Zool. Soc. London, 1907, p. 463) gives the index-numbers (greatest length x greatest breadth, in millimeters) of the skull as 483–496. The present specimen is therefore smaller than any that he examined.

Family RHINOLOPHIDAE

Rhinolophus monoceros Andersen

Japanese: Hinakikugashira-kômori

One adult male; Suiriko, Taichu-siu, central Formosa; November 19, 1932.

Measurements.—Head and body, 42 mm.; tail, 23; hind foot, 7; ear, 15.5; forearm, 37.5.

Skull.—Greatest length, 15.5 mm.; basilar length, including incisors, 12; greatest breadth, 7.5.

Remarks.—This is one of the smallest of the Formosan bats and is probably very rare there, as Årnbäck-Christie-Linde (Ann. & Mag. Nat. Hist., ser. 8, vol. 2, pp. 237–238, September, 1908) mentions only two males from Kagi. The type is a female.

Family HIPPOSIDERIDAE

Hipposideros armiger terasensis Kishida

Japanese: Taiwan-kagurakômori

Four males, two females; Suiriko, Taichu-siu, northern Formosa; December 4, 1932.

Remarks.—According to Horikawa, this bat is common throughout Formosa. This form must be compared with *H. swinhoii* from Amoy; but unfortunately I have no specimens of the latter form. The iris is "slate colored" (H. Orii).

Measurements (in the flesh).—Head and body, 100–106 mm.; tail, 47–59; hind foot, 17.5–18; ear, 33–35; forearm, 90–93.

Skull.—Greatest length, 31.5–33 mm.; basilar length, including incisors, 25.5–27; zygomatic breadth, 17.5–19.

Family VESPERTILIONIDAE

Myotis muricola orii, subsp. nov.

Japanese: Orii-hôhigekômori

One male; Taiheizan, Taihoku-siu, northern Formosa; September 15, 1932.

One male; Arisan, central Formosa; April 19, 1933.

Type.—An adult male; Taiheizan, Taihoku-siu, northern Formosa; September 15, 1932; no. 35, collection Marquis Yamashina; collector, H. Orii.

Diagnosis.—Very similar to *Myotis muricola muricola* (Gray) from Java, but the forearm averages a trifle shorter (33–34 mm., instead of 36–39). It may be distinguished by the larger second upper premolar, which is one-half to two-thirds the length of the first upper premolar. Typical *muricola* has a very minute second upper premolar.

Measurements (in the flesh).—Head and body, 40, 41 mm. (type); tail, 32 (type), 34; hind foot, 6.5 (type), 7; ear, 11.5 (type), 10; forearm, 33, 34 (type).

Skull.—Greatest length, 13, 13.5 mm. (type); basilar length, including incisors, 11, 11.1 (type); zygomatic breadth, 8, 8.5 (type).

Remarks.—We have another species, *Myotis taiwanensis* Årnbäck-Christie-Linde, from Formosa, but it is much larger; head and body, 49 mm.; forearm, 40–41; and the upperparts yellowish brown (in alcohol). *Myotis muricola orii* has a black back, the hairs more or less tipped with pale brown; under side mouse gray, the hairs distinctly tipped with grayish white or washed with pale brown (Arisan specimen). The iris is "slate colored" (H. Orii).

Pipistrellus pipistrellus (Schreber) subsp.?

Japanese: Yôroppa-iekômori

One male; Tamsui, northern Formosa; March 14, 1933.

Remarks.—This specimen seems to be referable to *P. pipistrellus* rather than to *P. abramus*. The outer margin of the ear below the tip is concave; inner margin of tragus less concave; wing membrane black instead of pale brown; upperparts uniformly dark rufous brown; throat dark slaty color; breast to vent, dark mouse gray with grayish white tips to the hairs; nasal tube very prominent. The iris is "slate colored" (H. Orii).

Measurements.—Head and body, 42 mm.; tail, 35; hind foot, 7.5; ear, 9; forearm, 33.5.

Skull.—Greatest length, 13.5 mm.; basilar length, including incisors, 11; zygomatic breadth, 9.

Pachyotus kuhlii insularis (J. A. Allen)

Japanese: Kashiradaka-kômori

One male; Riran, southeastern Formosa; August 26, 1932.

Measurements.—Head and body, 70 mm.; tail, 50; hind foot, 13; ear, 12; forearm, 52.

Skull.—Greatest length, 19 mm.; basilar length, including incisors, 16; zygomatic breadth, 12.5.

Remarks.—I have identified the above skin as *Pachyotus kuhlii insularis* because Howell (Proc. U. S. Nat. Mus., vol. 75, p. 19, 1929) says that the Fukien example is indistinguishable from *insularis* of Hainan; and moreover, Osgood (Publ. 312, Field Mus. Nat. Hist., vol. 18, no. 10, p. 229, 1932) has pointed out that *Pachyotus kuhlii kuhlii* has a longer forearm, 60.8–64.3 mm. The iris is "clove brown" (H. Orii).

This bat seems to be rare in Formosa and this example is the second specimen obtained in the island. The first specimen from Formosa is in my collection, captured by Horikawa at Seisui-gai, Taikogun, Taichu-siu, central Formosa, during July, 1923 (Kuroda, Dobutsugaku Zasshi, vol. 37, p. 4, 1925).

Family CERCOPITHECIDAE

Macaca cyclopis (Swinhoe)

Japanese: Taiwan-zaru

One male, one female; Koshun, southern Formosa; June 7, 8, 1932.

Measurements (in the flesh).—Male and female, respectively: Head and body, 400, 360 mm.; tail, 456, 345; hind foot, 145, 125; ear, 37, 30.

Skull.—Male and female, respectively: 201.5, 197 mm.; basilar length, including incisors, 66, 60; zygomatic breadth, 166.5, 164.

Fukuyoshi Cho, Akasaka, Tokyo, Japan.

VARIATION IN PROPORTIONS AMONG MAMMALS, WITH SPECIAL REFERENCE TO MAN

By Charles B. Davenport

In a study of the development of children I have been impressed by the changes of proportions that different parts of the body show from fetal to adult life. Two illustrations of these changes of proportion are given in figures 1 and 2. In figure 1, which shows changes with age in the intermembral index or the changes in the total arm length to leg length (total leg length being 100), we see that beginning with the third month of intra-uterine life the index falls from 127 to 84 at age 14, and then rises slightly. In this case the change of proportion is uniformly decreasing from an early fetal stage to adolescence.

A comparison of this index with that of the anthropoid apes (data for which we owe largely to Dr. A. H. Schultz) suggests an interpretation. The intermembral index of the anthropoid apes is a very large one (table 1). In the case of the adult gibbon it is in the neighborhood of 135, and even the young have a large index. Indeed, apparently in most Primates the arm develops

at first faster than the leg, but before the middle of gestation the arm begins to lag behind the leg. At any rate, the human fetal proportions are like those

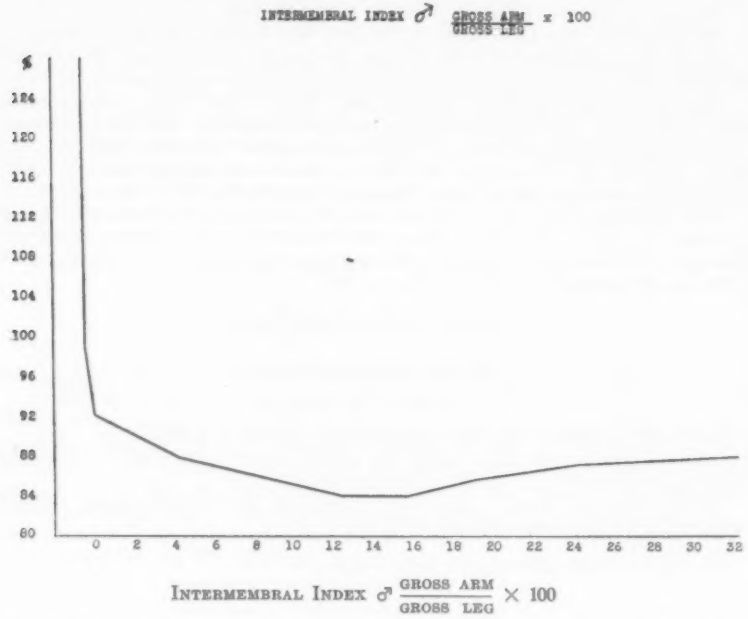

FIG. 1. Curve of changes in the average intermembral index of Nordic males (i.e. 100 × gross arm length ÷ gross leg length) at different ages in intrauterine and postnatal life.

TABLE 1

Intermembral index

Promops nasutus (bat)	219
Pongo pygmaeus (orang)	140
Hylobates hoolock (gibbon)	135
Gorilla gorilla (gorilla)	118
Pan satyrus (chimpanzee)	107
Canis familiaris (dog)	94
Phascolomys mitchelli (wombat)	86
Lemur variegatus (lemur)	73
Microtus pennsylvanicus (field mouse)	69
Homo sapiens (man)	68
Macropus rufus (kangaroo)	42
Dipus orientalis (jerboa)	34

of the young gibbon. The infant gorilla has an intermembral index of about 125 and this decreases in the adult to about 117. The arm of the in-

fant, therefore, begins to grow like the arm of other Primates long at first and then relatively shorter; but whereas in most other Primates the arm remains longer than the leg, in the child the leg early begins to grow so much the more rapidly that at birth the arm is already shorter than the leg.

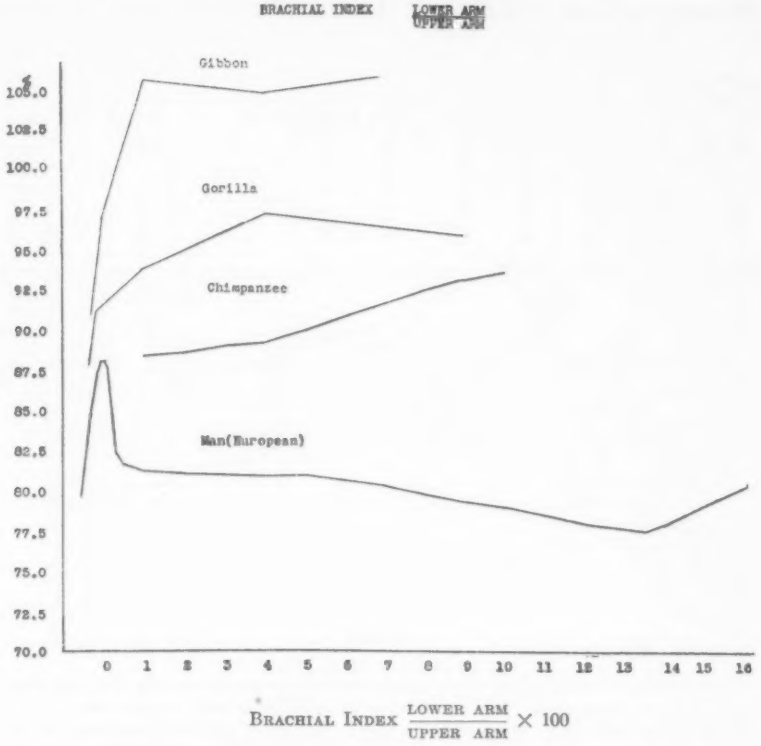

FIG. 2. Comparative curves of changes in the average brachial index (i.e. 100 × lower arm length ÷ upper arm length) at different ages in intrauterine and post-natal life, shown for gibbon, orang-utan, chimpanzee, and man (European). (For gorilla on graph, read orang-utan.)

To the comparative mammalogist the high intermembral index of the human fetus indicates a derivation of *Homo* from types which had strikingly long arms. The human child in relative length of arm and leg follows first the ordinary anthropoid path but goes beyond the other anthropoids in relative arm reduction. In view of the fact that *Tarsius* and *Lemur* have a relatively

low intermembral index the high index in the human child would suggest immediate origin from brachiating rather than quadrupedal ancestors.

In figure 2 is shown the development of the brachial index, or the proportional length of the lower arm, the upper arm remaining constant at 100. The determination of the brachial index in the early stages is difficult, but the curve as shown is probably in close accord with the facts. It will be

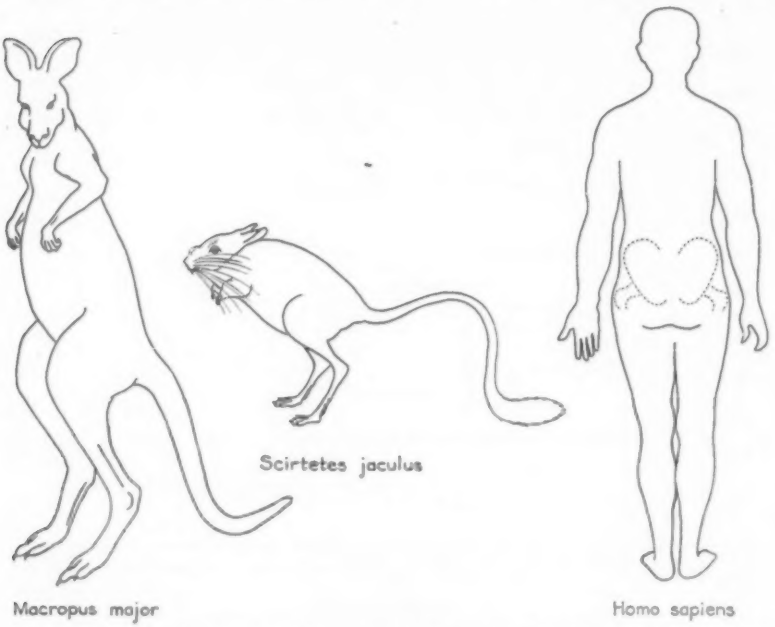

FIG. 3. Outline drawings of three mammals that use predominantly their posterior appendages for locomotion, showing tendency to reduction in anterior appendages. The comparison of these three types suggests that if the human anterior appendage has undergone a phylogenetic reduction comparable with that undergone by the other two, man's ancestors must have had long arms and probably had brachiating habits. The species represented are, from left to right, *Macropus major*, *Scirtetes jaculus* and *Homo sapiens*.

noted that beginning at the third month of gestation with a value of about 80, the index rises at birth to about 88, and then gradually falls away to 78 at adolescence. What is the meaning of these changes of proportion?

It appears from Schultz's tables that the brachial index of young gibbons is, on the average, less than that of adults and the same rule holds for the orangutan; so in them, too, the index increases to birth. In these anthropoids the

crural index of the infant stage is around 90, not far from the index attained by the human child at birth. While in the case of gibbon the index rises slightly after birth and tends to remain at a level in the adult of about 110,

TABLE 2

Appendicular ratios: Adult mammals

	A/L	H/A	R/H	F/L	T/F	H/F	R/T
Bat	219	36	156	55	83	156	294
Sloth	169	52	92	55	82	160	180
Gibbon	129	47	113	54	87	113	147
Gorilla	117	56	79	55	83	119	113
Chimpanzee	109	54	88	55	84	106	111
Dog	94	52	94	51	95	94	93
Homo	68	56	80	53	88	71	61
Kangaroo	42	45	120	36	178	53	36

A, net arm length; F, femur length; H, humerus length; L, net leg length; R, radius length; T, tibia length.

TABLE 3

Odobenus	YOUNG WALRUS	ADULT WALRUS	PHYLOGENETIC INFERENCE: ANCESTORS HAD:
NA/NL	73	102	Leg longer
F/NL	33	38	Femur shorter
T/F	206	161	Femur shorter
H/F	115	151	Humerus shorter
R/T	53	71	Tibia longer
H/NA	52	57	Humerus shorter
R/H	93	76	Humerus shorter

Abbreviations as in Table 2. NA, net arm (excluding hand); NL, net leg (excluding foot).

TABLE 4

Age changes in proportions

	GORILLA		INFERENCE: ANCESTORS HAD:
	Young	Adult	
H/NA	53	56	Humerus relatively shorter
R/H	88	80	Humerus relatively shorter
	Pan schweinfurthii		
R/T	115	106	Tibia relatively shorter
T/F	82	84	Tibia relatively shorter

in the case of the orang the proportion decreases somewhat, but remains in the adult at a higher level than in adult humans. This remarkable curve of the human brachial index may be interpreted thus: The human child in the

growth of its arm proceeds along the path taken by other catarrhines. Its lower arm, at first very short, tends to grow more rapidly than the upper arm and to become nearly equal to it. However, at birth the brachial index leaves the anthropoid path, and the lower arm grows relatively slower until it reaches the point of 78 per cent of the upper arm which is not far from the index that we have in gorillas, but less than in chimpanzees, and much less than in the other anthropoids.

The fact that in the human child the brachial index rises to such a high point suggests that the ancestral path it is traveling is one that has led to a large brachial index. It suggests man's derivation from the anthropoids and, indeed, from other brachiating Primates. If man had been derived directly from lemur-like forms in which the index is smaller than in anthropoids, we could not account for the high index attained by the human child. However, *Tarsius* has a very large brachial index (125 to 145), but this form is specialized for hopping rather than for quadrupedal locomotion.

Thus the study of the changes during development of these two indices supports the view that man's ancestors were brachiating animals, and illustrates the principle that early ontogenetic stages may throw important light upon the phylogenetic history when a comparison is made between the corresponding ontogenetic stages of related species.

As is well known there are two other groups of mammals in which the anterior appendages are much shorter than the posterior appendages, namely, the kangaroo and the jumping mouse (fig. 3). It is probable that the phylogenetic history of these groups could be rather accurately ascertained by a study of the changes in the intermembral index of the fetuses. Also, we might learn more of the phylogenesis of the bats, with their remarkable appendicular ratios in the adult, did we know these ratios in embryos. Table 2 illustrates some of the differences in appendicular ratios of adult mammals, upon which light deserves to be thrown. I add (tables 3 and 4) some data on the proportion of appendages in young and adult walrus and young and adult Primates, with the phylogenetic inferences that might be drawn.

I have been disappointed to find, however, in museums a lack of fetal material in the various groups of mammals. The point of the present paper is to urge the collection and preparation of fetus of different families of mammals by field collectors. It is believed that by a study of the changes of proportions during embryonic development studied in the more aberrant of the different mammalian types, much assistance will be given in the determination of phylogeny.

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NOTES ON THE NEW YORK WEASEL (MUSTELA NOVEBORACENSIS)

By D. G. Nichols and J. T. Nichols

At Mastic, Long Island, on June 1, 1934, a female weasel was shot in wet, open land, broken by hedges of maple, oak, and pepperidge, and with a thick growth of blueberry. The following observations are based on entries in the notebook of D. G. Nichols.

On June 1, I was in bay-side lots when I heard a weasel approaching along one of the old dikes, known locally as cattle markers. It was carrying a shrew. I shot it. The shrew (*Sorex cinereus*) was undamaged except for a small hole in the top of the head.

Supposing that the weasel taken on June 1 must have young ones, I lay in wait on June 3 along the same marker, and shot another weasel, a male that was without question immature.

While looking for a den of young weasels on June 4 I searched this cattle marker very carefully. A live Norway rat was leashed and allowed to run down several likely looking burrows. At one he entered with hesitation. I heard a squeal, let go the leash and plugged up the entrance with an eel pot. The rat was soon back in my trap followed by a weasel, and the rat was killed before I had time to notice that they were both in the trap. Left for a few minutes the trap was soon occupied by three weasels and a few remains of the rat.

These three weasels lived together for about a week in a small wire cage constructed for them (5 x 2½ x 1 ft.) which I kept in the garden, and in which I placed a wooden box (1 ft. square), later replacing this with a section of hollow log as a hiding place. One lived until about August 25. Meanwhile some interesting data on this species were obtained which seem to add something to our knowledge of its habits and behavior.

The young male, no. 200, shot June 3, was quite unlike no. 198, the female of June 1, being appreciably larger, its coat smoother and grayer, its tail less bushy and fatter at the base. The young female, no. 205, skinned June 11, was somewhat intermediate in character of pelage between no. 198 and no. 200.

The weasel that lived until about August 25 had a pelage similar to no. 198, and was, for a time, thought to be the adult male of this brood. However, as it was a small animal about the same size as the others it could scarcely have been such. Perhaps females attain adult appearance at an earlier stage than males, which throws slight doubt on no. 198's having been surely an adult. The lower parts of all five were white, but about August 1 the throat of this individual became yellowish. This color gradually deepened and extended until at the animal's death the entire under parts were yellow. Unfortunately this animal died when I was away and unable to examine it critically or preserve it.

The male taken June 3 measured: Total length, 310 mm.; tail vertebrae, 112; hind foot, 37. The two females, taken June 1 and June 11, measured, respectively: Total length, 270, 285; tail vertebrae, 95, 87; hind foot, 32, 32.

Judging growth rate from Hamilton's (1933, pp. 318–320) figures of measurements up to 6 weeks (captive animals) it seems probable that the young male of June 3 was as much as 3 months old, or born the beginning of March, which would seem very early.

FOOD

No. 198, when shot, was carrying a long-tailed shrew (*Sorex cinereus*). The location of the brood of weasels was near a known colony of long-tailed shrews, which likely formed an important item in its food supply.

The three individuals caught entered the trap after the rat and promptly killed and ate it. Dead rats placed in their cage were partly eaten (usually the viscera and portions about the neck). On the other hand, two live rats, one large and one small, that were placed in the cage and went into the hollow log with the weasels were unharmed. In fact these rats were thought to have caused the death of two of the three weasels, which followed shortly, though just how is uncertain. The weasels may have been hurt if not killed by the rats or even have gotten some infection from them. The following notes refer to food given the single surviving captive.

Dead mice (*Microtus*) given it were eaten in the neck region. The viscera also were devoured. Chipmunk bodies and a young rabbit were treated in the same way. It partook to some extent of gray squirrel but cared less for this, eating a bit of the viscera.

A few dead birds were eaten with avidity, almost the entire bird except the feathers being consumed.

Live frogs were taken eagerly, and eaten almost completely, except for the hind legs, which were usually left intact.

A dead black snake was partaken of when placed in the cage. On the other hand a live box turtle that lived in close proximity to the weasel for more than two weeks, during part of which time the weasel must have been hungry, was left unscratched.

Swallowtail butterflies and humming-bird moths (*Hemaris thysbe*) were pursued eagerly and eaten with avidity. For instance, on July 29 the weasel was supplied within a short time with 5 of these moths, a yellow swallowtail, and a large skipper butterfly. Though it pursued this last with great eagerness its attempts to seize it were unsuccessful and the butterfly escaped through the cage wires. One of the moths was handed it through the wires, the others it pursued and captured as they flew about the cage, immediately taking them inside its hollow log as it did the swallowtail, where one could dimly see it eating with apparent relish. There is little doubt in my mind but that it enjoyed the chase. When a couple of katydids were placed in the cage it took one but left the other. These insects may have been less attractive by reason of their sluggishness, but seemingly were also less to its taste. It ate salt-water mummichogs, mackerel, and raw meat, being particularly fond of liver.

Fresh water was kept always available and was frequently taken, a little at a time. During the hot weather appetite decreased noticeably and water consumption increased. A little cold milk was put in the pen occasionally and though very seldom sampled at first, later was taken if the weasel was very hungry (and sufficiently coaxed).

BEHAVIOR

The three weasels remained under cover unless interested in something outside. Then they would come out and glide about the cage, calling their soft twittering note, evidently the same as described by Hamilton (1933, p. 293). After a month or so the

surviving individual recognized my call and other noises, such as tapping on the wire, or responded when I held my hand quietly beside his log. Any food item of sufficiently small size was snatched and carried back under cover. The tendency, when not hungry, was to take all available food and store it in the log, though the weasel never let any meat get stale there.

The single surviving individual behaved in the same way after its companions were gone, spending most of its time in the hollow log. Sometimes it would come out and one could see it from a distance looping swiftly and incessantly back and forth against one end or side of the cage with restless energy. It came to associate my coming to the cage with receiving food. At such times it would weave about the cage, in and out of its log, stuttering and expectant.

Its head was held erect, big ears facing forward and little pink nose vibrating. Its large eyes had an intense expression, a peculiar pearly luster, but were apparently of less use than its nose. For instance, when I placed some liver on top of the cage, the weasel immediately sprang up and, clinging to the wire, began to pull bits through. I took the liver away and dropped it to the bottom of the cage. The weasel began darting about in search, returning to where the taste and smell still clung to the wires, and actually running over the liver where it lay on the ground without at first noticing it. A few weeks after capture the weasel became so bold as to take food from my hand through the wire.

In seizing anything alive it used its front paws as well as its mouth, and if an animal was sufficiently large and active, also held it with its lithe body. A dead house sparrow with a string attached was placed in the cage. In its usual manner the weasel came from the log and seized the nearest part of the dead bird and attempted to take it back into the log. I gave the string a twitch and it immediately dashed for the head, biting the neck and back of the skull. I drew the bird to the top of the cage, jerking it all the while to make the weasel think it was alive. Finally, when biting failed to quell the bird, it grasped it firmly in fore-paws and teeth, throwing itself on the ground and rolling over and over from one end of the cage to the other. This action was repeated several times. During this process the weasel became covered with blood-stain. Within several hours the stain was thoroughly cleaned off.

The specimens described were collected by D. G. Nichols. The observations of captive animals and preparation of the paper are by the authors jointly. The advice of members of the mammalogy staff of the American Museum (especially G. G. Goodwin) have been most helpful in studying the material and preparing this paper.

LITERATURE CITED

HAMILTON, W. J., JR. 1933. The weasels of New York. Amer. Midland Nat. (Notre Dame, Ind.), vol. 14, no. 4, pp. 289-344, pls. 6-9.

NOTES ON TWO SPECIES OF WOOD RATS IN CAPTIVITY

By Horace W. Feldman

A small colony of each of two species of *Neotoma* was maintained at the Laboratory of Vertebrate Genetics, University of Michigan, Ann Arbor, during 1928, 1929, 1930, 1931, and 1932. One stock was derived from an adult female and two male hoary wood rats, *Neotoma micropus canescens*, caught three miles north of Carlsbad, New Mexico. The other originated from six female and nine male white-throated wood rats, *N. albigula albigula*, caught at points near Oracle and Tucson, Arizona. The writer is indebted to Dr. Lee R. Dice and Mr. Philip Blossom for securing and identifying the foundation animals. Grants from the Faculty Research Fund, University of Michigan, supported this work during 1928 and 1929.

We maintained these wood rats in the laboratory under the conditions successfully used for members of the Old World genus *Rattus*. They were confined in wire cages, which had a floor space of 15 x 16 inches and which provided a total space of about 2100 cubic inches. Their diet consisted of one of the uncooked commercial dog foods; a mixture of wheat, corn, and sunflower seeds; rolled oats; and lettuce leaves. In addition, they received cod-liver oil equal in quantity to five-tenths of one per cent by weight of the total food consumed. A small bundle of shredded paper in each cage provided a scanty substitute for their habitually large nests. Each week the sawdust bedding was replaced with clean material. Fresh water was available to the rats at all times. The temperature of the laboratory was maintained within five degrees of 70°F. except on occasional days in July and August.

The rats were handled at intervals when weighed or transferred to new cages. There was no indication that they became tame during several years of life in the laboratory. They always struggled violently when handled and sometimes broke their incisor teeth by biting the forceps that held them. In the cages they were timid but not extremely nervous and excitable. When the cage was disturbed they retreated to the rear and thumped the floor with their hind feet in the manner of rabbits. Those individuals born and reared in the cages were not perceptibly tamer than those that were caught in the field.

In general, the rats did not seem to suffer physically from their confinement. The one difficulty in keeping them resulted from their marked tendency toward fighting when two strangers were caged together. This existed in spite of our precautions to place them in a cage familiar to neither individual. We did not attempt to cage more than two together. Of these attempts about three-fourths were unsuccessful. The sex of a stranger did not seem to affect its acceptability. We have had two of the same sex living peaceably together for some months. After a male and female had accepted each other

as cage companions they lived quite amicably, even during the pregnancy of the female and after the birth of the young. A litter of young over two months of age would often disturb the family group if allowed to remain in the cage with the parents. Fights between two unfriendly rats usually started within an hour after the animals were placed together and in the case of the larger hoary wood rat these encounters would end fatally for the loser within twenty-four hours. The smaller white-throated wood rats fought effectively but less persistently. All matings required daily observation. From their behavior in the cages we would be inclined to say that these wood rats in their natural habitat probably have no social life other than a brief mating period and the association of the female and her young before the latter are weaned. It is possible to assume, however, that a male may live in the immediate vicinity of his mate's nest for some time. In such cases he is probably a factor in dispersing the young after weaning is complete.

The two species had very similar food habits. Both preferred the cereals and green food to the dog food, which contained about twenty per cent animal proteins. Food consumption by the larger, more sluggish *Neotoma micropus* was little greater than that of *N. albigula* and in proportion to weight it was much less. The wood rats ate about one-half as much food as Norway rats eat per one hundred grams of body weight. Their diet seemed adequate for the various stages of development in view of the fact that adult *micropus* reared in the cages averaged 27 grams heavier in body weight than wild-caught adults; cage-reared *albigula* averaged 14.4 grams heavier than wild-caught adults. It was interesting to observe that wild-caught *albigula* ate mesquite beans with great relish when given a limited supply, while the cage-reared individuals much preferred sunflower seeds and maize to the ancestral food.

We secured few data on longevity because all individuals were either killed by us or by cage mates while still in a vigorous condition. We had rats of both species that were adult when captured and that lived as much as forty months in the laboratory. Cage-reared animals were in some cases over three years old before they were destroyed.

In no case was copulation observed. Gestation in *N. micropus* is less than 33 days and in *N. albigula* less than 30 days. These figures are based on the length of time that elapsed between the date when a male was placed with the female and the date when the young were born; and in *albigula* on the minimum time between successive litters. All of the eleven litters of the hoary wood rat were born in February, although females were caged with males throughout the year. Each consisted of two young, which were raised at least to weaning. Only one litter was produced each year by a female.

The white-throated wood rats produced a total of 29 litters of one to three young per litter with an average of 2.1. The modal litter was two young. These litters were produced from April to September. One female gave

birth to four litters, totaling eight young during 1932 and several produced more than one litter during a breeding season. Of the 61 young of this species born in the laboratory, eight disappeared before they were old enough to be weaned.

From these observations one would be inclined to believe that *albigula* is polyoestrous and *micropus* is monoestrous, at least under cage conditions. It is also evident that in *albigula* an oestrum may occur either at parturition or during lactation, since litters may be produced at intervals of 30 to 50 or more days in this animal. Lactation persists for 20 to 25 days after parturition if the young remain alive.

Since fertility in a rodent is a very complicated matter it is difficult to draw conclusions regarding the wood rats with which we worked. Litter size varied within narrow limits. In *N. micropus* we made 33 matings which proved compatible and secured young from seven. In *N. albigula* we made a total of 85 compatible matings of which 17 produced live young. In each form a little less than one-fifth of the compatible matings were fertile. Compatibility here refers to the behavior of the rats rather than the reactions of their sex cells. The low fertility probably was due in large measure to the environment. We succeeded in mating seven female and twelve male *N. micropus* with at least one mate each with which they did not immediately fight. Of these, five females and seven males produced offspring. In *N. albigula* we successfully mated 22 females and 23 males. Young were produced by nine females and eleven males. We are inclined to believe that the sterility of some of these rats was due in part to the environment and in part to a hostile attitude toward the mates.

Wood rats are born at a stage of development somewhat more advanced than are members of the genus *Rattus*. The auditory meatus opens at three days and the eyes at twelve. The coat is well developed at the age of two weeks. Young wood rats have a peculiar tendency to hold tightly to the nipples of their mother. At first it was thought that this hold was continuous during the early life of the young. Observation revealed, however, that during periods of quiet about their nest they may relax this hold when they are not more than a week old. On slight disturbance they attach themselves firmly and are then dragged about the cage by their mother. When they reach the age of three weeks the attached young become a great handicap to the mother's movements. The tendency to cling to the nipples persists until weaning at about thirty days.

Since our populations of wood rats were small, our data on sex ratios are of slight value. *Neotoma micropus* produced, in a total of 22 young, 16 males and 6 females. It was interesting to observe that in this species both members of each litter were always of the same sex. In *N. albigula* we noted, in a total of 61 young, 35 females and 26 males. Here the distribution of the sexes in the litters was quite at random.

The growth of the cage-reared wood rats was quite uniform. Individuals varied less than ten per cent of the body weight at any given age. Weights of 19 *N. micropus* and 40 *N. albigula* were taken at the ages of 15, 30, 60, 90, 150, and 300 days. The averages that follow are based upon these individuals. It was impossible to examine the young rats detached from the mother before they were 15 days old without anesthetization. This was deemed an undesirable complication. The *N. micropus* at birth appeared to weigh about ten grams; the *N. albigula* appeared to be about two-thirds as large. The average weights in grams of *micropus* at the ages noted above were 37.6, 91.2, 178.1, 254.0, 340.9, and 403.5, respectively. The average weights of *albigula* at the same ages were 22.4, 50.6, 92.8, 127.8, 163.5, and 198.0, respectively. Maturity in body size and sexual development occurred in both forms at about the age of 300 days. At this age their first breeding season was at hand. We obtained offspring from both sexes in each of the two species when they were a year old. The growth of males and females was not significantly different. The larger adult size of *N. micropus* resulted from a much more rapid growth throughout the period. This was especially marked up to the age of 150 days. The increments were in some periods almost twice as great as those of *N. albigula*.

The observations upon these two species of *Neotoma* indicate that although the animals are in most respects similar they differ in a striking way in growth and reproductive cycle.

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SHAM LOUSE-PICKING, OR GROOMING, AMONG MONKEYS

By H. E. Ewing

That monkeys indulge in sham louse-picking, or grooming, is well known to keepers in zoological gardens, as well as to students of primate behavior. But why do they engage in such activities? Concerning this question there exists some divergence of opinion. Knottnerus-Meyer (1928, p. 78), Director of the Zoological Gardens at Rome, states: "In this connection it should be noted that the monkeys are *not* hunting for fleas, since healthy monkeys are never, or only very rarely, afflicted with these tormentors. The toilet consists rather of a combing-out of the fur; and what the monkeys are constantly searching for and eating is the crystallized secretions of the skin, whose salty flavor tickles their palates. So long as monkeys are able to bathe frequently, as in the Roman monkey paradise, it will be found that they very rarely indulge in these so-called flea-hunts."

Sham flea-hunting, or louse-picking, is in fact, as has recently been abundantly shown, only one of those general behaviors of monkeys coming under the head of grooming. It is not the desire or purpose of the writer to discuss

here grooming in general, but only that phase of grooming wherein a monkey persistently searches his own skin or that of another for the purpose of finding something to put in his mouth. It does not include hair-plucking, a form of grooming wherein a monkey dislodges hairs by means of jerking them out by their roots. To do this, the tips of the hairs are held firmly between the thumb and fingers of one hand, then by means of a sudden jerk a hair or hairs are dislodged. Sham flea-hunting should also exclude the biting off of hairs, a behavior rather rarely observed among monkeys.

Those who are interested in the genetic aspects of grooming should read Yerkes' (1933) recent paper on this subject. Before proceeding with a narration of some personal observations of sham louse-picking, I should like to quote another authority on monkey behavior. Zuckerman (1932, p. 57) writes: "Monkeys, and to a lesser extent apes, spend a great part of the day grooming one another. An animal will carefully examine a fellow's coat with its fingers, eating many of the odds and ends that it finds. These are carried to its mouth either by hand or sometimes, after licking a tuft of hair, by direct nibbling." And he adds (1932, p. 58): "The fruits of the search generally turn out to be small, loose, scaly fragments of skin, particles of skin secretion, thorns, and other foreign matter."

The remarks of these two authorities certainly appear logical. However, when the writer carefully examined several monkeys at the National Zoological Park at Washington, he was surprised at not being able to see any crystallized secretions of the skin, or any scaly fragments of the same. Both by the unaided eye and by the use of a hand lens the following were examined: Adult mona monkey, *Cercopithecus mona*; adult male Japanese monkey, *Macaca fuscata*; adult male Rhesus monkey, *Macaca mulatta*, and a one-third grown male Philippine macaque, *Macaca syrichta*. When examined, all of these monkeys were in a healthy condition. None was on exhibit. One was being kept at my home. The only foreign particles that I found in the fur were chaff particles from the hay in the cages, or in a few instances dirt particles. There were many chaff particles, but these did not adhere to the skin, and the monkeys paid little or no attention to them.

Human sweat is known to be salty, in fact it may at times leave a visible deposit of salty material on the skin, where there is repeated and profuse sweating. Remembering this, it was thought that observations on human sweat might throw some light on the problem of motive in the sham flea-hunting activities of monkeys. So it was decided to experiment with human sweat to see if visible crystals would be left on my skin following evaporation of a thick film of sweat. By means of artificial heat and blankets a profuse sweating was produced on my forehead, from which about 1 cubic centimeter of sweat was collected in a vial. Now a small area on the left fore-arm was marked off, and all of this area was covered with a thick film of sweat and let dry. No crystals could be seen. A binocular microscope with a magnifica-

tion of 10 times was next employed. No crystals of any kind could be detected with it.

Next a few drops of human sweat were spread out on a microscope slide and allowed to dry. Very minute cubic crystals were deposited. The largest of these was measured under the compound microscope. It was 102μ long. The smallest was 12μ long, and 10μ wide. Thus it is seen how the smallness of these crystals would explain why I did not detect them on my skin.

When we reflect on the minuteness of the crystals deposited from a layer of sweat much thicker than any that would be produced by a sweating monkey, why should we suppose that a monkey picks them up? I believe that they do not pick up sweat crystals. If human eyes can not detect isolated sweat crystals, it might be inferred that the eyes of monkeys do not.

But do monkeys like minute salt crystals? To answer this question the following observation was made on a third grown Philippine macaque, *Macaca syrichta*, obtained from the National Zoological Park. He had become quite tame, and I had his complete confidence, as well as his devotion. One evening, while he was out of his cage, I held one hand over his eyes and scratched the back of his head (something he was immensely fond of) while a band of salt was being shaken on the middle of his tail. The crystals were gently rubbed down into his fur. The band was only about an inch long. Then the monkey was left for observation. Before long he began to groom the woolen garment upon which he was sitting, and soon came around to his tail. Almost instantly his eyes caught sight of some of the salt grains, and immediately his tongue was applied. His fondness for the salt was directly manifest. He groomed and licked the salty spot again and again. For four minutes this continued. Then he passed to the woolly garment. Back again he came to the salty part of the tail. For thirteen more minutes he alternated his attention between the garment and the salty ring on his tail.

This experiment showed that this monkey was very fond of salt, that when he found a salty place in his fur he would confine almost all his grooming to this place. But salty crystals large enough to be picked up with the fingers apparently do not normally exist on a monkey's skin. How, then, do monkeys get any salty flavor from the things that they pick up? I found that when human sweat evaporated on my forearm it left a distinctly salty flavor to the bases of the hairs, which, when the latter were plucked, could be detected by touching the same to my tongue. Here, I think, is one answer to the question of motive in sham louse-picking. The sweaty secretions of the skin impart a salty flavor to the hairs and to any particles adhering to the surface of the skin, as well as to the epidermis itself. Monkeys like the salty flavor of the things that they pluck from their skin.

Do monkeys obtain bits of cast epidermis in their grooming activities? The many observations I have made have shown that they seldom obtain pieces of epidermis. The young Philippine macaque, which I kept at my

home, was observed just once to flick up a piece of epidermis with his finger nails. Actual observations on other monkeys show that seldom do they do this while grooming.

What then are the chief elements of their diet as obtained from the skin? The answer is hairs. Hairs that are becoming loose, or hairs that are already shed, these are the chief items. This point was particularly demonstrated by observing a family of Rhesus monkeys, *Macaca mulatta*, consisting of an adult male and two females. All members of this family habitually indulged in sham louse-picking, and all ate the objects obtained during the search. The type of grooming exhibited was that common among macaques. It was a sort of a combining method, a systematic laying back of swaths of hair. These monkeys would observe a speck, or what appeared to be a small object on the skin. Then the fingers would be applied to pluck it. The plucking motion was repeated until incidentally a hair would be removed. This hair was immediately placed in the mouth and usually eaten. Although no member of this family was addicted to definite "hair-plucking," yet so many hairs were obtained by their common grooming methods that every member had extensive bare spots in its fur. One monkey, the favorite "wife," had fully half of her back bare because of the grooming actions of her mate.

The "louse-hunting type" of grooming has been observed in nearly all of the Old World monkeys kept at the National Zoological Park, but has been observed in only a few of the New World species.

LITERATURE CITED

KNOTTNERUS-MEYER, TH. 1928. Birds and beasts of the Roman Zoo (Translated by B. Miall). Century Co., New York and London, pp. vi + 378, pls. 40.

YERKES, R. M. 1933. Genetic aspects of grooming, a socially important primate behavior pattern. Journ. Soc. Psych., vol. 4, no. 1, pp. 3–23.

ZUCKERMAN, S. 1932. The social life of monkeys and apes. International Library of Psychology, Harcourt, Brace and Co., New York, pp. xii + 356, pls. 24.

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NEW EVIDENCE ON THE ANCESTRY OF ANTILOCAPRA AMERICANA

By Curtis J. Hesse

For many years the phylogeny of the pronghorn has been much discussed in print. The writer wishes now to make a new suggestion as to the possible line along which this peculiarly American mammal might have been derived. All of the material described here has been collected in the last ten years. It is not now asserted that the controversy about the ancestry of *Antilocapra americana* is definitely settled; but it is believed that the *Capromeryx* material here discussed may furnish the key to this question. Final conclusions must await the discovery of *Capromeryx* horn cores.

The genus *Capromeryx* was described by Matthew (1902, p. 318) from the Pleistocene deposits of Hay Springs, Nebraska. The original species, *C. furcifer*, was based on a left lower jaw. This was the first fossil described that seemed to represent a near ancestor to the living *Antilocapra americana*. The genus *Capromeryx* was regarded by Matthew as a descendant of the *Blastomeryx-Merycodus* group, leading in the direction of the modern pronghorn. Ten years later, Taylor (1911, p. 192) at the University of California, described a second species of *Capromeryx*, although he considered the generic reference as questionable, since he had only a small immature lower jaw. This second species, *C. minor*, was from the Rancho La Brea asphalt pits. In a later work Chandler (1916, pp. 111–120), with more complete material from the same locality, described the dentition and skeletal elements in detail. Some time later, Furlong (1925, p. 145) described a third species, *C. mexicana*, from Pleistocene deposits of Mexico. The last two species are certainly of Pleistocene age. In the case of the genotype, *C. furcifer*, there may be some doubt as to its stratigraphic position, since both Pliocene and Pleistocene vertebrates are now known to occur in the Hay Springs section. It is certain that the genotype is more closely allied to the Pliocene forms now described than it is to the species that are known from the west coast and from Mexico.

In the last report on the Snake Creek fauna, Matthew (1924, p. 200) described and figured the third lower molar of an antelope-like animal, to which he gave the name *Merycodus altidens*. Matthew noted that this specimen was not a true merycodont, but was more "advanced" than any species previously known. A close comparison of this middle Pliocene M_3 with the figured genotype of *Capromeryx* and the described species shows clearly that they are all members of the same genus; in fact, except for slight differences in size they seem to be specifically identical. This tooth then represents a fourth species, *C. altidens*, and furnishes the first recorded occurrence of the genus *Capromeryx* in the Pliocene.

The specimens described in the following report are all definitely referable

to the genus *Capromeryx* because of their premolar pattern, their jaw proportions, and other peculiarities of their skeletal elements. The new species from Hemphill County, Texas, is more primitive in its characters than any of the others. Unfortunately the Kansas specimens all lack M_3. Therefore they cannot be directly compared with the Snake Creek species. Nevertheless the two faunas are approximately of the same age, and are known to have many forms in common. Therefore it seems best to refer the Kansas material provisionally to *C. altidens*.

In 1928, isolated teeth of *Capromeryx* were discovered in the middle Pliocene of Texas. These were referred to as "*Dorcameryx optimae gen. et. sp. nov.*" in a preliminary faunal list, prepared by Matthew, which appeared in "The Geology of Hemphill County, Texas" by Reed and Longnecker (1932, p. 66). In my opinion this material does not warrant special generic designation. Furthermore, since the name was published without description, *Dorcameryx optimae* is a *nomen nudum* and therefore without standing. [The author of this paper has now given *Dorcameryx* a definite status, under the International Zool. Comm., opinion no. 4, as a synonym of *Capromeryx*. Ed.]

Capromeryx altidens (Matthew)

Merycodus altidens Matthew, Bull. Amer. Mus. Nat. Hist., vol. 50, art. 11, p. 200, fig. 60, 1924.

Type.—A. M. N. H., no. 18981. A fragment of the left lower jaw with M_3 in place.

Paratypes.—A. M. N. H., no. 18981a, M_3; also A. M. N. H., no. 18981b, last lower molars.

Type locality.—From the upper level of the Snake Creek beds, Quarry no. 1, and Pliohippus draw.

Referred material in the University of Kansas Museum of Vertebrate Paleontology.—From the Rhinoceros Hill fauna: no. 3678, fragment of cheek tooth series, P_3 to M_1; no. 3840, left lower jaw, P_4 to M_2; no. 3485, lower jaw fragment, M_2; no. 3790, anterior part of right lower jaw, P_2 to P_4; no. 3319, complete radius; nos. 3381–3382, parts of two scapulae; no. 3840, fragment of pelvis; no. 3483, complete metacarpal; calcaneum, toe bones and fragments. From the Tertiary beds of Clark County, Kansas: no. 3711, left lower jaw, Dp_4 to M_1, complete metacarpal, tibia and the distal end of a metatarsal.

Locality and stratigraphic position of the referred material.—The specimens referred to *C. altidens* in this report were collected at two localities in western Kansas. The larger part of this material came from the Ogallala formation (Rhinoceros Hill beds) in the northeastern corner of Wallace County, Kansas. It was associated with an extensive middle Pliocene fauna, of about the same stage of development as the Beecher Island (Wray Beds) of northeastern Colorado, or the Hemphill (Hemphill Beds) fauna of Texas, both of which are also referable to the Ogallala formation. These faunas are all allied to that of the upper Snake Creek beds (of Matthew, 1924, p. 200) but so far there is little to indicate that the latter beds may be included within the Ogallala. The second lot of material (K. U. Mus. Vert. Paleont. no. 3711) came from the late Tertiary sand in the eastern part of Clark County, Kansas. It was collected from beds which also yielded a skull of *Aphelops sp.* Since the specimens are, so far as one can determine, conspecific with the Rhinoceros Hill and Snake Creek forms, I do not hesitate to refer these beds to the middle Pliocene.

DESCRIPTION OF THE KANSAS MATERIAL

Lower Dentition.—(Figures 1a–1b–2a). Two-thirds the linear dimensions of *Antilocapra americana*; molars and premolars hypsodont; P_1 absent; post-canine diastema twice the length of premolar series; P_2 small, much as in *Merycodus*; antero-internal

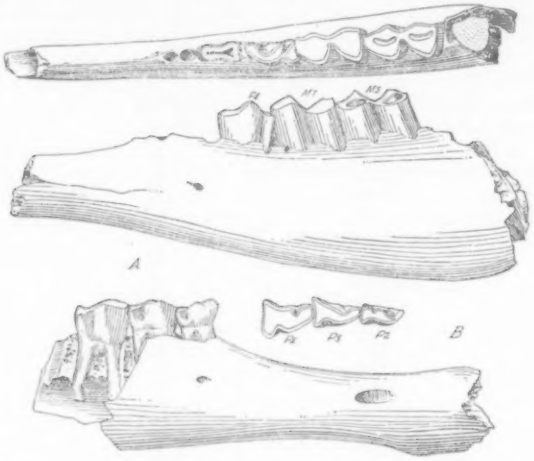

FIG. 1. A, *Capromeryx altidens*, Univ. Kansas Mus. Vert. Paleont., no. 3480; left lower jaw, P_4 to M_3, natural size. B, *Capromeryx altidens*, Univ. Kansas Mus. Vert. Paleont., no. 3790; anterior part of right lower jaw, P_2 to P_4, natural size; Kansas Pliocene.

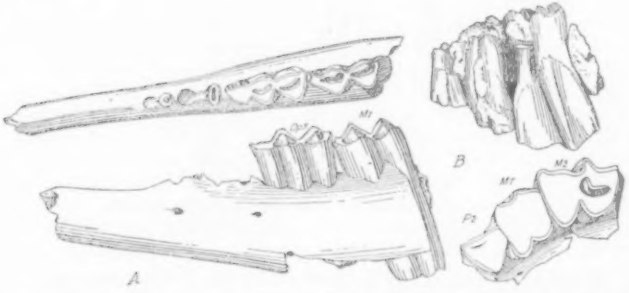

FIG. 2. A, *Capromeryx altidens*, Univ. Kansas Mus. Vert. Paleont., no. 3711; left lower jaw, Dp_4 to M_1, natural size. B, *Capromeryx altidens*, Univ. Kansas Mus. Vert. Paleont., no. 3618; upper left cheek teeth, P_2 to M_2, natural size; Kansas Pliocene.

inflection deep, posterior inflection shallow, neither extending to base of tooth; P_2 sub-triangular, one antero-internal deep inflection, posterior external inflection shallow, posterior edge of tooth broad (width more than one-half antero-posterior length) and square; P_4 sub-molariform, less triangular in outline, antero-internal inflection sharp,

not extending to base of tooth; P_4 (in K. U. Mus. Vert. Paleont. no. 3840 unworn) shows antero-internal inflection very prominent, decreasing in depth and width from crown

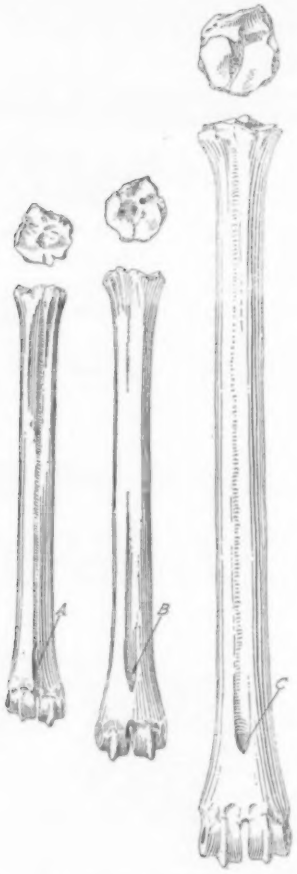

FIG. 3. Comparative views of the metatarsal bone of: A, *Merycodus necatus*, Univ. California Mus. Paleont., no. 26781; anterior median groove open to distal end; Barstow Miocene. B, *Capromeryx altidens*, Univ. Kansas Mus. Vert. Paleont., no. 3483; distal end of anterior median groove closed over; Kansas Pliocene. C, *Antilocapra americana*, Univ. California Mus. Vert. Zool., no. 31157; anterior median groove also closed over; Recent. All drawn approximately two thirds natural size by Owen J. Poe.

to base; molars antilocaprid, external styles not prominent (K. U. Mus. Vert. Paleont. no. 3711 has unworn M_1 in which styles are prominent near crown); ribs low, teeth hypsodont; M_3 with well-developed third lobe.

Ramus.—Deep beneath premolars, from M_3 to mid-point of post-canine diastema, ventral outline convex as in *Antilocapra*; from above showing slight inward curve (toward mid-line) beginning beneath P_3 and continuing to middle of diastema; mental foramina opposite posterior edge of symphysis; nutritive foramen beneath P_2 or P_3.

Upper dentition.—(K. U. Mus. Vert. Paleont. no. 3618, figure 2b) heavily worn; P^4 small, triangular, no ribs on outer side, possibly because of excessive wear; M^1 heavily worn at angle peculiar to antilocaprids; mesostyle prominent, other styles absent; ribs not shown; antero-inner crescent sharp in outline, extending toward mid-line of palate more than the posterior crescent, giving the tooth a "skewed" appearance; M^2 resembling the same tooth in allied forms; mesostyle prominent; parastyle present but not prominent; ribs absent; upper teeth intermediate in size between *Merycodus furcatus* and *Antilocapra americana*.

Scapula.—(K. U. Mus. Vert. Paleont. nos. 3480-3481) intermediate in form and size between *Merycodus* and *Antilocapra*; relative proportions as in *Antilocapra*, but angle of coronoid process less obtuse though well-developed; groove extending from coracoid notch into glenoid fossa not as wide as in *A. americana*; glenoid fossa nearly circular in outline, not broken by base of coracoid process as in living form.

Radius.—(K. U. Mus. Vert. Paleont. no. 3319). No indication of fusion with ulna; intermediate in size between that of *Merycodus* and that of *Antilocapra*, the radius of *Capromeryx altidens* (143 mm.) being one-third longer than that of *M. furcatus* (120 mm.) and about two-thirds as long as that of *A. americana* (218 mm.).

Metacarpal.—(K. U. Mus. Vert. Paleont. no. 3711). Resembles closely that of *Antilocapra* but is smaller; slightly larger than in *Merycodus furcatus*; unciform facet almost even with that of the magnum; line of fusion of two halves not as plain as in *Merycodus*; width of distal articulation in proportion to shaft not as great as in *Merycodus*. In *Merycodus* and *Capromeryx* the distal articulation turns slightly backward, bringing the anterior keels in line with the anterior plane of shaft. In *Antilocapra americana* the distal articulation lies directly beneath the shaft, thus causing the anterior keels to project beyond the anterior plane of the shaft; this may be correlated with a more upright position of the phalanges in the living form.

Pelvis.—(K. U. Mus. Vert. Paleont. no. 3840). Incomplete acetabulum and half of ilium present; intermediate in size between corresponding parts of *Merycodus* and *Antilocapra*; resembles latter more closely than the former.

Tibia.—(K. U. Mus. Vert. Paleont. no. 3711). Proximal one-third missing; shows no important distinctions from either *Merycodus* or *Antilocapra*; is intermediate in size.

Calcaneum.—(K. U. Mus. Vert. Paleont. no. 3711). Approaches that of *Merycodus* most closely in size (i.e. length). In ratio of width to length the calcaneum of *A. americana* is more slender than that of *Merycodus* or that of *Capromeryx*. Chandler (1916, p. 119) wrote that the calcaneum of *C. minor* was in some respects similar to that of *Ilingoceros*, but that in most of its characters it resembled the calcaneum of *A. americana*.

Metatarsal.—(Figure 3b, K. U. Mus. Vert. Paleont. nos. 3483, 3711, 3678, 3676). Much as in the other two genera; anterior median groove closed over at most distal portion, as in *A. americana*, not open for full length as in *Merycodus* (fig. 3); keels of distal articulation straight, not turned toward mid-line as in *Merycodus*; posterior median groove as in the pronghorn, much narrower than in *C. minor*.

Phalanges.—Proximal phalanx not peculiar, similar to that of *A. americana*, *Ilingoceros*, *Capromeryx minor*, and *Merycodus*; median phalanx similar to that of *Merycodus*; anterior surface sharply ridged just back of articulation, not rounded as in the later forms.

Capromeryx texanus new species

Merycodus sp. nov., Matthew, in Reed and Longnecker, The Geology of Hemphill County, Texas, Univ. Texas Bull. no. 3231, p. 65. 1932.

Type.—Left lower jaw, Univ. California Mus. Paleont. no. 30337 (figure 3); P_2 to M_3, condyle, angle, ascending ramus, and incisor teeth missing. Otherwise well preserved, with moderately worn teeth.

Type locality and stratigraphic position.—Univ. California locality no. V2832, in the northwest corner of Hemphill County, Texas, near the county line; in the northwest corner of Land Section 26, Block 43. The few fossils found here had weathered from loose sands and gravels. This is just below or may be included within bed no. 3 (Reed and Longnecker locality 16, 1932, p. 65). With this specimen were fragments of a camelid and an upper molar of *Nannippus* cf. *lenticularis*. The age of these beds is certainly Pliocene, and they are a southern extension of the Ogallala formation of Darton. The rich Hemphill middle Pliocene fauna on Coffee Ranch lies at the base of bed no. 1 (Reed and Longnecker, locality 20, p. 66), about 100 feet stratigraphically above this locality and about 22 miles south of it. The facts that the Hemphill specimens of *Capromeryx* are more advanced in their characters and more elevated in their stratigraphic position, suggest that the species *C. texanus* may belong to the upper part of the lower Pliocene.

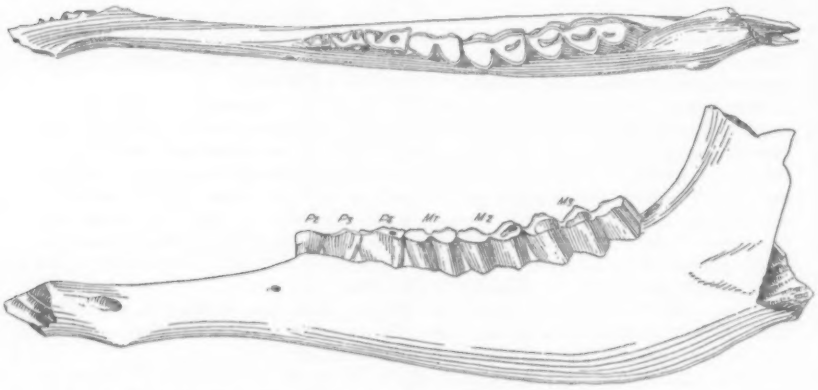

FIG. 4. *Capromeryx texanus*, type specimen, Univ. California Mus. Paleont., no. 30337; a left lower jaw, P_2 to M_3, natural size; Texas Pliocene.

Diagnosis.—Intermediate in size between *Merycodus necatus* and *Capromeryx altidens*; jaw not shortened as in *C. minor* and *C. mexicana* (Chandler, 1916, p. 115); premolars not as high crowned as in the known species of *Capromeryx*, but higher crowned than in any described species of *Merycodus*; ramus slender in outline as in *Merycodus*, but slightly larger.

Systematic position.—This lower jaw is definitely *Capromeryx* on the basis of its size, crown height of the entire tooth row, and crown pattern of the premolar teeth. In these characters it is advanced over *Merycodus*. It is a third species within the *altidens-furcifer* group, but is more primitive with respect to the slenderness of the ramus (resembling a merycodont), and to the less high-crowned premolar teeth. It is markedly different from the Pleistocene *minor-mexicana* forms in that the premolars are not as high crowned or as short anteroposteriorly; neither the tooth row nor the ramus is shortened, nor is the depth of the ramus beneath M_3 proportionately as great as in *Capromeryx texanus*.

GEOLOGIC RANGE AND GEOGRAPHIC DISTRIBUTION OF THE GENUS CAPROMERYX

The earliest occurrence of the genus *Capromeryx* is probably indicated by the species, *C. texanus*, an animal that may have lived during the later part of the lower Pliocene. In the middle Pliocene beds of the high plains at Snake Creek in Nebraska, Rhinoceros Hill and Clark County in Kansas, Optima in Oklahoma, and Hemphill in Hemphill County, Texas, the species *Capromeryx altidens* has been collected. There are no published records of the occurrence of this genus in any of the upper Pliocene faunas; but the occurrence of certain mammals in the upper Snake Creek deposits (*Castor californicus*, etc.) suggests that the fauna of these beds may be transitional to that of the upper Pliocene. In Pleistocene deposits, *Capromeryx* has been recorded from Hay Springs in Nebraska, as well as from the Rancho La Brea and the McKittrick asphalt pits of California, from Pleistocene beds near Tequixquiac, Mexico, and probably from the Bautista beds of California (teeth which are not determinable with certainty). In two of the Pliocene localities, Optima, Oklahoma and Hemphill, Texas, this genus was by no means uncommon, but in all other localities it is rare.

Comparison with other forms.—The genus *Capromeryx*, as pointed out above, is made up of two groups of species. One of these groups is formed by *Capromeryx furcifer*, *C. altidens*, and *C. texanus*, the other is formed by *Capromeryx minor* and *C. mexicana*. The first three species are intermediate in characters (so far as they are known) between the merycodonts and *Antilocapra*. The two species forming the second group are distinct from the first three because of their shortened lower jaw and their slender metapodial bones. From the living pronghorn they are distinguishable by their peculiar horn cores. Since we know nothing as yet of the horn cores of either *C. furcifer*, *C. altidens*, or *C. texanus*, the two groups of species for the present must be kept in one genus.

Proantilocapra platycornea, recently described by Barbour and Schultz (1934, p. 3), must be studied in detail before its position with reference to *Capromeryx* can be determined. The figures and description given by the authors make this animal appear to be more closely allied to *Merycodus* than to *Capromeryx*.

Sphenophalos nevadanus, which has also been suggested as a possible ancestor of the pronghorn (Furlong, 1931, p. 33), is much larger than any known species of *Capromeryx*. In fact the teeth and limb elements are but slightly smaller than those of *Antilocapra*. *Capromeryx* and *Sphenophalos* are, however, much alike in their structural details. If the horn cores of the Pliocene species of *Capromeryx* were known the relations of the two genera could be cleared up at once. The remaining West Coast specimens of *Sphenophalos* (Rattlesnake, Pinole Junction, Moraga, etc.) are referred to that genus rather than to *Capromeryx* solely on the basis of their slightly larger size and their geographical occurrence.

Aletomeryx gracilis (Lull, 1920, p. 85) is quite distinct from any of the above discussed forms because its teeth are quite brachydont and suggestive of those of *Dromomeryx*. *Tetrameryx shuleri* (Lull, 1921, p. 163) of the Texas Pleistocene is also distinct from *Capromeryx*. Its teeth approach those of *Antilocapra* in size. The lower dentition of this four-horned form has recently been described by Stock (1930, p. 9), who writes that the teeth resemble those of the modern pronghorn more closely than they do those of *Capromeryx minor*, and that the ramus is heavier and thicker than that of *Capromeryx minor*. *Tetrameryx* was probably (Stock, 1930, p. 18) a much heavier, less fleet-footed creature than *Capromeryx*.

Neomeryx finni (Parks, 1925, p. 432) is, as the original describer pointed out, as large as *Antilocapra americana*, while *Capromeryx* is less than two-thirds that size (Parks, 1925, p. 434). Parks also noted (p. 431) in discussing the relationship of *Neomeryx* that this genus was close to *Antilocapra*, and also that "It approaches more closely to *Meryco-*

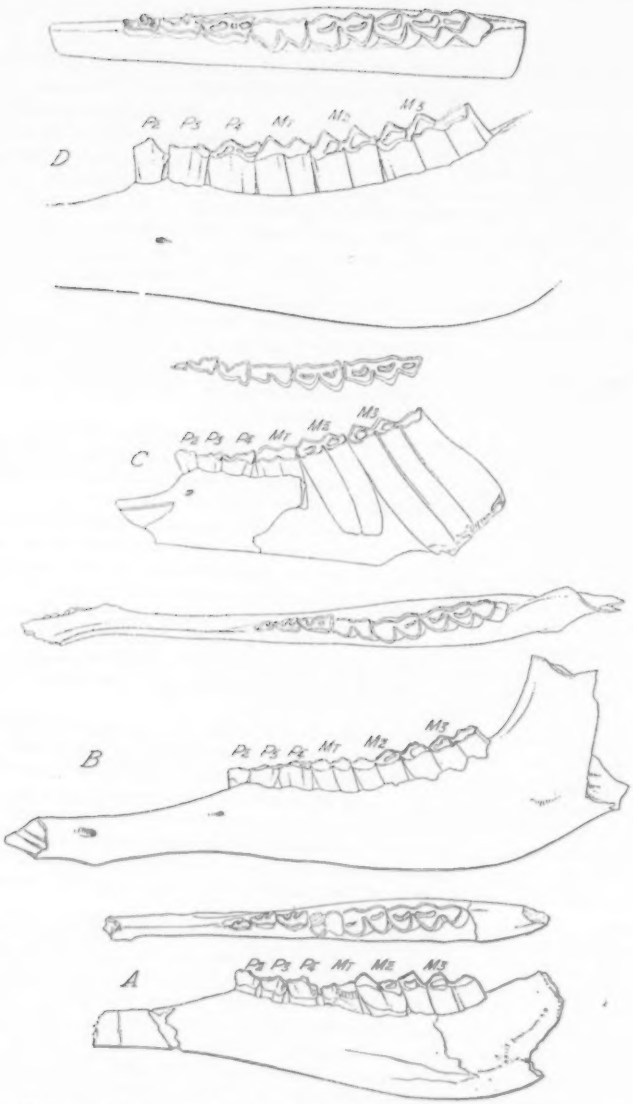

FIG. 5. Comparative views of the lower jaws of: A, *Merycodus necatus*, Univ. California Mus. Paleont., no. 26781; Barstow Miocene. B, *Capromeryx texanus*, Univ. California Mus. Paleont., no. 30337; from the Pliocene (lower?) of Texas. C, *Capromeryx furcifer*, type specimen, Amer. Mus. Nat. Hist., no. 2771; from the Pleistocene beds of Hay Springs, Nebraska. D, *Antilocapra americana*, Univ. California Mus. Vert. Zool., no. 31157; male, Fresno Co., Calif.; Recent. All drawn three-fourths natural size by Owen J. Poe.

dus altidens Matthew," a species which has been shown in this paper to be a member of the genus *Capromeryx*.

LITERATURE CITED

BARBOUR, E. H. and C. B. SCHULTZ. 1934. A new antilocaprid and a new cervid from the late Tertiary of Nebraska. Amer. Mus. Novit., no. 734, pp. 1–4, 1 fig.

CHANDLER, A. C. 1916. Notes on the *Capromeryx* material from the Pleistocene of Rancho La Brea. Bull. Dept. Geol., Univ. Calif., vol. 9, pp. 111–120, 4 figs.

FURLONG, E. L. 1925. Notes on the occurrence of mammalian remains in the Pleistocene of Mexico, with a description of a new species, *Capromeryx mexicana*. Bull. Dept. Geol., Univ. Calif., vol. 15, pp. 137–152, 11 figs.

———. 1931. Distribution and description of skull remains of the Pliocene antelope *Sphenophalos* from the northern Great Basin Province. Carnegie Inst. Washington, Publ. no. 418, pp. 27–36, 1 fig., 5 pls.

LULL, R. S. 1920. New Tertiary Artiodactyles. Amer. Jour. Sci., ser. 4, vol. 50, pp. 83–130, pl. 1, 25 figs.

———. 1921. Fauna of the Dallas sand pits. Amer. Jour. Sci., ser. 5, vol. 11, pp. 159–176, 5 figs.

MATTHEW, W. D. 1902. List of the Pleistocene fauna from Hay Springs, Nebraska. Bull. Amer. Mus. Nat. Hist., vol. 16, pp. 317–322.

———. 1904. A complete skeleton of *Merycodus*. Bull. Amer. Mus. Nat. Hist., vol. 20, pp. 101–129, 3 pls., 21 figs.

———. 1924. Third contribution to the Snake Creek fauna. Bull. Amer. Mus. Nat. Hist., vol. 50, pp. 59–210, 63 figs.

PARKS, W. A. 1925. A new antilocaprid from the Post-glacial of Saskatchewan. Bull. Geol. Soc. Amer., vol. 36, pp. 432–434, 1 pl.

REED, C. L. and O. M. LONGNECKER. 1932. The geology of Hemphill County, Texas. Univ. Texas Bull., no. 3231, pp. 1–98, 9 figs., map.

STOCK, C. 1930. Quaternary antelope remains from a second cave deposit in the Organ Mountains, New Mexico. Los Angeles Mus., Pub. no. 2, pp. 1–18, 3 figs.

TAYLOR, W. P. 1911. A new antelope from the Pleistocene of Rancho La Brea. Bull. Dept. Geol., Univ. Calif., vol. 6, pp. 191–197, 6 figs.

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DESCRIPTION OF A NEW RACE OF MICROTUS CALIFORNICUS

By Donald M. Hatfield

It has been known for some time that specimens of *Microtus californicus* taken in the salt-marsh areas of the southern San Francisco Bay region differ from those taken in the Berkeley Hills. Kellogg (1918, p. 8) remarks that, "The individuals which live in the marshes are much blacker than those that live on the grassy hillsides." Grinnell (1913) gives an account of the differentiation of other vertebrates found in these marshes.

The question now presents itself: Are the color differences between the upland and marsh populations of a heritable kind, or are the darker colors of the salt-marsh animals due to the action of the salt or other chemical agents present in the soil and on the vegetation?

To test the tenability of the idea that the darker color of the *Microtus californicus* living in the marsh was due to the effect, during one generation, of substances peculiar to the marsh area, I have bred at the same time, under identical conditions, both the marsh and upland forms to the fourth generation. Study of this material shows that the characters peculiar to each form are maintained at least to that generation. Of the marsh form raised in captivity, I have at hand, of the fourth generation, three skins and skulls, two adult and one sub-adult, one adult skin only, and two adult skulls only; and, of the upland form, two skins and skulls, and one skull only, all adult. These are now in the collection of the Museum of Vertebrate Zoology. In the marsh form, the skins definitely show a darker coloration, while the skulls are more flattened and possess a longer rostrum than those of the upland form—differences which also distinguish sub-adult and adult individuals taken in the wild state. For a more precise statement of these differences see below under the account of the here newly-named subspecies.

Thus in the genus *Microtus*, we have found that characters distinguishing two kinds from two different habitats are heritable when the animals are bred in the same habitat. Sumner's (1932) studies revealed, among many other things, this same state of affairs in *Peromyscus*. Now we know that another genus of small rodents, belonging to a different subfamily, the Microtinae, displays the same heritable quality of certain of the differences which have commonly been used in diagnosing subspecies.

Of the two kinds of *Microtus californicus* studied, one, the marsh-inhabiting animal, seems never to have been provided with a distinctive name. It may now be named and diagnosed as follows:

Microtus californicus paludicola, new subspecies

Type.—Male, adult, skin and skull; number 12718, Mus. Vert. Zool.; Melrose Marsh, Alameda County, California; December 15, 1910; collected by A. M. Alexander; original number 1108.

Range.—In so far as known, salt marsh areas of the southern end of the San Francisco

Bay region, from west base of El Cerrito, Albany, Alameda County, around the south end of the Bay to Redwood City, San Mateo County.

Diagnosis.—Size: medium (see measurements). Color: general shade dark; mass effect of dorsal area ranging from Prout's brown to mummy brown (color terminology after Ridgway, 1912); basal portions of dorsal hairs varying from blackish mouse gray to blackish plumbeous. Ventral hairs dark plumbeous basally, cinereous terminally. Skull: rostrum long; braincase narrow, shallow, and rounded anteriorly.

Comparisons.—From *Microtus californicus californicus*, as found in the upland region around San Francisco Bay, *M. c. paludicola* differs as follows: Total length less; coloration darker; dorsal area ranging from Prout's brown to mummy brown as opposed to light Brussels brown or Saccardo's umber. Dorsal hairs varying from blackish mouse gray to blackish plumbeous basally as opposed to deep neutral gray. Ventral hairs dark plumbeous basally, rather than deep neutral gray. Skull: Rostrum longer; braincase narrower and shallower.

From *M. c. aestuarinus*, this race differs in being smaller throughout and slightly more grayish.

Measurements.—Ten adult and sub-adult specimens (five males and five females) present average and extreme measurements in millimeters as follows: Total length, 165.3 (153–176); length of tail, 43.5 (38–49); length of hind foot, 20.0 (19–21); basilar length of Hensel, 25.1 (23.8–26.2); palatilar length, 14.4 (13.8–14.8); greatest zygomatic breadth, 16.3 (15.8–16.8); mastoid breadth, 12.9 (12.5–13.6); height of skull measured between ventral faces of upper tooth rows to top of skull at interobital constriction, 9.7 (9.1–10.2); length of braincase (measured from the right optic foramen to the right exoccipital at a point just dorsal to the right occipital condyle), 13.0 (12.5–13.5); breadth of braincase, 11.3 (10.8–11.9); medial depth of occiput, 7.3 (7.0–7.8).

Specimens examined.—All from California, and in the Museum of Vertebrate Zoology. Total number, 58, as follows: Alameda County; West base of El Cerrito (knoll), within city limits of Albany, 6; ½ mile east of Bay Farm Island, at Oakland city limits, 25; Melrose Marsh, 10; Hayward Landing, 6; Alvarado, 3. San Mateo County; Redwood City, 8.

Remarks.—While the specimens from Hayward Landing do not show the characteristic flattening in the interorbital region, their flattened occiput and dark coloration definitely place them with the new form. My study leads me to disagree with Von Bloeker (1932, p. 136), who states that reddish-colored mice are characteristic of the marshes of the south arm of the San Francisco Bay. Certainly all specimens of *Microtus* from that region examined by me show about the same amount of reddish, or even less of it than do corresponding specimens of *Microtus* from adjacent hillsides. It is true, however, that harvest mice (*Reithrodontomys*) are more reddish in the salt marsh areas of that region. Apparently the marsh environment affects the two mice in different ways.

The nomenclature for the several geographic races of *Microtus californicus* has been well worked out by Kellogg (1918). However, the precise application of the name *Arvicola californica* Peale is, and probably always will be, seriously open to question. According to Kellogg (1918, p. 9), " . . . in all likelihood the type of *Arvicola californica* came from San Francisquito Creek, near Palo Alto, California, and . . . it was taken on October 26, 1841." The mouth of San Francisquito Creek extends out into salt-marshes, and in that region is found a typically palustrine fauna. Immediately adjacent, toward the uplands, is found a fresh water riparian habitat. Unfortunately, there is no way of knowing from which habitat the type specimen was taken. If taken in the salt marsh area, it would mean that the subspecific name *californicus* would apply to the marsh form.

However, in view of the uncertainty, and the confusion that would result from such

designation, it seems better to assume that the type specimen came from an upland habitat. I have not seen the type specimen, but I gather from Lyon and Osgood (1909) and from Kellogg (1918) that the skin is discolored, probably from having been in alcohol, and that in all probability the skull does not belong with the skin. Thus, examination of the type would not be likely to aid in more definitely allocating the name.

LITERATURE CITED

GRINNELL, J. 1913. The species of the mammalian genus *Sorex* of west-central California, with a note on the vertebrate palustrine faunas of the region. Univ. California Publ. Zool., vol. 10, pp. 179–195, figs. 1–6.

KELLOGG, R. 1918. A revision of the *Microtus californicus* group of meadow mice. Univ. California Publ. Zool., vol. 21, pp. 1–42, 1 fig. in text.

LYON, M. W., JR., and W. H. OSGOOD. 1909. Catalogue of the type-specimens of mammals in the United States National Museum, including the Biological Survey collection. U. S. Nat. Mus. Bull. no. 62, pp. i–ix, 1–325.

VON BLOEKER, J. C., JR. 1932. Three new mammals from salt marsh areas in southern California. Proc. Biol. Soc. Washington, vol. 45, pp. 131–137.

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A NEW WOODCHUCK FROM KANSAS

BY J. D. BLACK

In 1914, when A. H. Howell was engaged in his study of the American marmots, only nine specimens were available from Kansas, all from the vicinity of Lawrence, and all supplied by the Museum of Birds and Mammals, University of Kansas. After he had examined this small series, consisting of six males and three females, one of the latter a subadult, Mr. Howell wrote C. D. Bunker, Assistant Curator of the Kansas Museum, that on the basis of the meagre material it was inadvisable to describe a new subspecies from eastern Kansas, but the specimens examined indicated that there might be a new race there, and suggested that additional material be secured. These same conclusions were published a year later in Mr. Howell's "Revision of the American Marmots," (North American Fauna, no. 37, 1915, pp. 24–25), at which time he pointed out the larger size of the hind foot and skull in females of *Marmota monax* from Kansas.

In the twenty years that have elapsed since the appearance of Howell's revision, a very satisfactory series of Kansas specimens has been accumulated in the museum at Lawrence. They have been collected, for the most part, by Fred Hastie, 7 miles southwest of Lawrence. This series proves conclusively that the preliminary suppositions based on the first nine specimens were correct. In addition to the characters mentioned there are several slight external and cranial differences which, taken as a whole, serve to distinguish the Kansas form readily from typical *Marmota monax monax*.

Appreciation should be expressed here to the Bureau of Biological Survey

for providing typical specimens of *Marmota monax monax* for comparison, as well as to Dr. H. H. Lane, Head of the Department of Zoology of the University of Kansas, under whose supervision this study has been carried on, for his counsel and for examination of the manuscript; and especially to C. D. Bunker, Assistant Curator in Charge, Museum of Birds and Mammals, University of Kansas, who has placed that institution's entire series of *Marmota* at my disposal, who suggested over a year ago the study resulting in the present paper, and who has been instrumental in securing a very fine series of Kansas specimens. It is a privilege, therefore, to designate this typically Kansas mammal as:

Marmota monax bunkeri, new subspecies

Type.—From 7 miles southwest of Lawrence, Douglas County, Kansas; adult female, skin and skull, no. 3089, Univ. of Kansas Museum of Birds and Mammals, Lawrence, Kansas; collected by Fred Hastie, March 8, 1920.

Distribution.—At least northeastern Kansas from Franklin County north to Doniphan County; limits of range unknown, but probably extending north into Nebraska and west in Kansas up the rivers for a considerable distance.

General characters.—Female as large as the male, with a very large hind foot and large skull; males slightly larger than in typical *Marmota monax monax*, thus making it the largest subspecies of the group. Coloration variable, similar to that of *monax* but averaging darker; legs and lateral stripe (almost always present) cinnamon-rufous or bright hazel. A typical gray phase and a black phase occur together. Feet always black and tail much less intermixed with grizzled buffy-white than is usually the case in *monax*. Braincase broader and flatter than in *monax*.

Color.—Underfur of upperparts varying from pallid neutral gray to rather bright ochraceous-buff terminally, and varying basally from dull blackish-brown to pure black. Long hairs of upperparts varying from clove brown to pure black, in either case broadly banded near the tip with white and then tipped by a narrow band of the dark color. Long hairs around the front legs nearly pure cinnamon-rufous or bright hazel, varying in intensity and saturation. These hairs are always lighter toward the tips and are black basally, the ratio of black to rufous also varying somewhat. Long hairs around hind legs sometimes almost like those around front legs, sometimes concolor with the back, usually intermediate between the two. On the majority of adult specimens there is a faint ventro-lateral stripe of cinnamon rufous intermixed with grizzled gray from the axilla to the groin. This cinnamon-rufous also invades the neck region ventrally to form a more or less distinct band of cinnamon-rufous or hazel across the lower throat. About two-thirds of the specimens examined have the long hairs of the back clove brown basally and about one-third are in the melanistic phase with these hairs black, in the latter case with the basal portion of the underfur also black so that the black is definitely dominant over the gray and white in the general color. On all the specimens examined the feet are black, the brown sometimes occurring in *monax* not being found. The tail varies from pure black to a very dark brown, sparsely if at all mixed with buffy or whitish hairs. The top of the head varies from seal brown to clove brown.

Skull.—Similar to that of *monax*, but those of females much larger than of females of typical *monax*, and as large as those of males from Kansas. Braincase more massive, broader and lower than in *monax*. The sagittal crest is well developed in only about one-half of the adult females examined and seems never to attain the high development

typical of the males. The maxillary tooth row averages considerably longer than in *monax*, and the teeth, though highly variable, are wider and heavier than those of *monax*.

Measurements.—(Type): Total length, 620 mm.; tail vertebrae, 145; hind foot, 95. Seven female topotypes: Total length, 624 (605–650); tail vertebrae, 149 (122–160); hind foot, 95 (90–108). Eleven male topotypes: Total length, 630 (602–653); tail vertebrae, 150 (120–189); hind foot, 94.4 (90–98).

Skull (*type*): condylobasal length, 101.3; palatal length, 60.5; postpalatal length, 36.2; length of nasals, 43.4; zygomatic breadth, 68; breadth across mastoids, 47; least interorbital breadth, 27.9; breadth of rostrum, 21; maxillary tooth row, 23. Seven adult female topotypes: Condylobasal length, 98.5 (95–100.5); palatal length, 57.9 (56–59.5); postpalatal length, 36.1 (35.5–37.2); length of nasals, 42.5 (41.6–42.7); zygomatic breadth, 66.1 (64.5–66.8); greatest mastoid breadth, 47 (45.5–49); least interorbital breadth, 27.7 (27–30); breadth of rostrum, 22.3 (20.6–23.7); maxillary tooth row, 22.2 (21–23). Eleven adult male topotypes: Condylobasal length, 98.2 (94–101); palatal length, 57.1 (55.5–59.3); postpalatal length, 36.7 (34–39); length of nasals, 42.1 (40–44); zygomatic breadth, 66.5 (65–69.2); greatest mastoid breadth, 48.2 (46.8–50.5); least interorbital breadth, 27.9 (26.2–29.5); breadth of rostrum, 22.3 (20.5–23.5); maxillary tooth row, 22 (20–23).

Specimens examined.—Sixty-one, from the following localities in Kansas: Douglas County, 36 skins and skulls, 20 skeletons or skulls only; Leavenworth County, 2 skins and skulls; Doniphan County, 5 skins and skulls; Franklin County, 1 skin and skull; Atchison County, 1 skull only.

Remarks.—The specimens from Franklin and Doniphan counties, as well as those from Leavenworth and Atchison counties, seem to be quite typical of this race, the maximum skull length so far found (102 mm.) being that of a male from Doniphan County. Two females from that county, both subadult, measure 97.2 and 98.5 in condylobasal length, with the other measurements in proportion. A specimen from McDonald County, Missouri, as well as those from Stone County, Missouri, appear to be typical of *monax*, lacking the large size and dark coloration of the Kansas form, so that intergradation may be expected to occur between the two forms somewhere in southern Kansas. One very interesting abnormality was found in the topotype series, an adult female (K.U., no. 3911) with an extra premolar in each of the four jaws, apparently the retention of a milk tooth, squeezed slightly median of the tooth row, second in the series in each jaw, and intermediate in size between the teeth before and behind it. The maxillary tooth row of this specimen was 25.5 mm. Another abnormality in tooth structure was that of an adult male topotype (K.U., no. 3920), where the maxillary tooth row measured 24.6, because of the unusually large size of the anterior premolar.

Summary.—In considering this form in contrast to *monax* it might be convenient to compare certain features of the two animals. The condylobasal length of the skulls of *monax*, according to Howell, averages 97.8 mm. in males and 91.2 in females. This is in contrast to averages of 98.2 for males and 98.5 for females of the Kansas form. The hind foot measurements for males of typical *monax* are given by the same authority as 82 and 88 (only two measurements are given), while that of females for the typical form averages 83. The hind foot of males of the Kansas form averages 94.4, and of females 95. The average total length of females of *monax* is given by Howell as 557, while the average of seven females from Kansas is 624. The maximum length of nasal bones of *monax* is given as 40.6, the average 38.7, in contrast to an average of 42.5, a minimum of 41.6, and a maximum of 43.4 in the Kansas females.

Museum of Birds and Mammals, University of Kansas, Lawrence, Kansas.

GENERAL NOTES

NOTES ON THE HIBERNATION OF A CAPTIVE BLACK BEAR

During the deer and bear hunting season in Michigan in the fall of 1934, extending from November 15 to November 30, the weather had been extremely mild. The kill of black bear, as evidenced by the Michigan Department of Conservation's check at the Straits of Mackinac, had been unusually heavy compared to previous years.

A captive male black bear, born in the spring of 1933 and captured as a cub, is a pet of the CCC camp at Wilderness State Park, Emmet County, Michigan. He is confined in a wire pen, with a large box attached to serve as a den. On the morning of December 3, 1934, the first heavy snow of the season began. By night about five inches had fallen. The temperature was 32°F. at 8 A.M., and went a few degrees lower during the day. The snow evidently annoyed the bear as he showed signs of uneasiness. He paced his pen, tried to escape through the wire, and went in and out of his den. Boughs of arborvitae (*Thuja occidentalis*) were placed in and around the entrance to the den. As soon as this had been done the animal crawled into the den and pulled the boughs over the entrance.

No more was seen of him until the morning of December 5, when he came out. The temperature was then 16°F. Two days later he again started to hibernate. He could be seen lying in his den, and appeared drowsy. Boughs were piled over the entrance and snow thrown on them.

Despite the fact that a buzz saw occasionally operated not far from his cage and a garage for seven trucks was built within forty feet, he did not come out again until 10 o'clock of the morning of March 5, 1935, when the temperature was 48°F.

His last meal before his hibernation, consisting of table scraps, was taken on November 29.

Upon his emergence in the spring his first acts were to micturate and defecate. The stools were bloody and greenish. The green color was caused by the foliage of arborvitae. Upon examination of his bedding it was found that he had eaten most of the foliage, as only the bare branches remained. The crusted snow on the floor of the pen seemed to hurt his feet. He took a short drink of water and retired for two days. Upon his second appearance he nibbled at bits of foliage of arbor vitae, but did not seem interested in the more solid food which was offered. His first meal of any size was on March 11. It consisted of a frozen fish, weighing about one and a half pounds. On March 12 he consumed a half a bucket of table scraps.

At the time of the animal's retirement for the winter there was a bare place upon his throat where the hair had been rubbed off by a leather collar. No appreciable amount of hair grew on this spot during hibernation, although the collar had been removed in the fall. His coat had taken on a new luster and his claws had grown noticeably. No difference in weight from the time he started hibernating until he came out could be noticed. Facilities for taking weights were not available. His disposition was apparently improved by hibernation, as previously he had been "cranky." A few days after his emergence he became extremely playful, and amused himself by swinging in an old rubber tire suspended by a chain from the top of the cage.

It is interesting to note that two days after this bear came out of hibernation, fresh tracks of a wild bear were seen for the first time this season in the woods nearby.—WILLIAM JOHNSTON HOWARD, *U. S. Department of the Interior, National Park Service, 812 Illinois Bldg., Indianapolis, Ind.*

A WEASEL GOES HUNGRY

Four miles north of Funkley, Minnesota, early on the morning of November 13, 1921, I watched from the top of a 30-foot spruce a weasel (probably *Mustela noveboracensis*)

hunting a varying hare (*Lepus americanus phaeonotus*) in a rather recent burn. The ground was covered with six inches of fresh snow, placing both animals, which had already assumed their winter pelage, in close harmony with their surroundings.

My attention was first attracted to the hare as it came hopping steadily but unhurriedly from the north. Directly in front of me, about 75 feet from the tree I had climbed, the hare crisscrossed back and forth at various angles over an open area about 20 feet in diameter. After producing a maze of tracks, the hare "froze" near one edge of the pattern. In a few minutes the weasel appeared, all his faculties focused on the warm trail. Expertly he followed its convolutions, passing at times within a few feet of the watching hare. Not until the weasel had followed every turn of the trail to within three feet of its termination did the hare skip off. It came out to the road almost directly below me, turned at right angles northward and was soon out of sight. At the road the weasel lost the trail, going south instead of north. He was soon aware of his mistake, for he circled until he came to a point within six feet of the trail and then ran parallel with it, once more in hot pursuit.

Ten minutes later the hare emerged from the north as before, came on directly to the tracked-up area, and continuing its stratagem, leisurely hopped about to leave its zigzag trail. Then it sat down quietly to wait for its sleek and persistent little enemy. The wait was not long, for the weasel soon came galloping along on the tracks in his businesslike fashion. His nose led him through the network with little trouble. He was almost upon the hare before it jumped off and followed the same path on which it had sped before. With ease the hare left the weasel far behind—the weasel's efforts seemed futile.

After about the same interval as before, the hare arrived a third time and repeated its previous maneuvers. The weasel, apparently as optimistic and intent as ever, soon followed. The maze was now more complicated but evidently not too baffling for the weasel; and the hare had to show his big heels again as the weasel approached him. This time the weasel failed to follow, having apparently lost faith in his venture. After examining a few brush heaps he vanished into the woods behind me.—Adolph Murie, *Assistant Wildlife Supervisor, Wildlife Division, U. S. National Park Service, Berkeley, California.*

APPARENTLY NEUTRAL RELATIONS OF WEASEL AND SQUIRREL

During the month of January 1935, Mr. F. F. Brunson stored some beef bones on the porch of his residence in Wilderness State Park, Emmet County, Michigan. A New York weasel, *Mustela noveboracensis*, was seen by members of the Brunson family to visit the bones several times daily and carry small bits of meat under the porch. A red squirrel, *Sciurus hudsonicus*, also visited the porch more or less regularly to secure small pieces of meat.

The animals were never seen eating at the same time, but on several occasions the squirrel was seen nibbling at the meat when the weasel arrived on the porch. At such times the squirrel seemed highly alarmed. It would run away from the meat as quickly as possible, and keep as much distance between itself and the weasel as the porch would permit. Apparently the weasel was little interested in the actions of the squirrel, as it was never noticed to pay any attention, or to give chase.

Several times the weasel was chased by two small dogs. It went into a drain opening under the porch and expressed its feelings by chattering at the dogs. These chases apparently caused it no lasting alarm, as it continued to visit the porch frequently for meat. Its tracks in the snow indicated that it did not travel far from the house, but seemed content to make trips between the meat on the porch and its hideout under the porch. Fear of the dogs may have kept if from making trips afield, but it is probable that a steady food supply and a safe retreat were the causes for its staying so close to

the house.—William Johnston Howard, *U. S. Department of Interior, National Park Service, 812 Illinois Bldg., Indianapolis, Ind.*

THE COYOTE AND THE AUTOMOBILE

During the course of seventeen trips by automobile from the mid-west to the Pacific coast, nearly all the species of mammals known to come to the highways to feed upon the victims that are killed by the cars, and in turn meet a similar fate, have been recorded.

The list includes the razor-back hog of the South, dogs, cats, skunks, opossums, wildcats, raccoons, badgers, ring-tailed cats, weasels, owls, buzzards, and hawks.

There are several other carnivorous animals that are known to seek food from the pavements, and that I have not yet found among the dead, namely, foxes, ravens and crows.

Until the last trip the coyote also was included in this list of unharmed carnivores, but I now have three records of the killing of this animal by automobiles. A friend reported that driving at night between Yuma and Gila Bend, Arizona, he ran into and killed an adult coyote. Between Deming and Lordsburg, New Mexico, Mrs. Bebb saw a dead specimen on the pavement.

On a clear day in mid-afternoon east of Gila Bend, an adult coyote trotting upon the pavement towards the car was spied, presumably searching for food. As the automobile drew near the animal left the highway and stopped by the side of the road, not over thirty feet away. He paid no attention to the passing car. Evidently, to him, such a meeting was not an unusual occurrence, but one that presented no occasion for fear or alarm.

During the return trip east, near Pyote, Texas, the remains of a juvenile coyote, thoroughly desiccated and flattened out, was found on the road.

So far not one species of fox has been identified either dead or alive. On one occasion a black bear crashed into the brush at the side of the road as the car approached.—William Bebb, *Evansville, Indiana.*

VALUE OF PREY-INDIVIDUAL ANALYSIS OF STOMACH CONTENTS OF PREDATORY MAMMALS

Most stomach contents analyses are presumably made to determine the ecological or economic status of the predatory mammal in question. The results are usually reported as per cent by volume or per cent by frequency (number of stomachs containing particular classes of food). Sometimes the number of individuals of each prey species in one or more stomachs is mentioned casually as though such information is of passing interest, but far from important enough to warrant study in great detail.

As a matter of fact, a knowledge of the number of individuals of each species eaten is of greater scientific and economic value than a knowledge of the volume composed by each. This is so because it allows comparison with figures on abundance of prey, on biotic or breeding potentials (Chapman, "The quantitative analysis of environmental factors," Ecology, 1928, p. 111), on economic status of prey, all of which are measured by individuals or activity of individuals. Furthermore such figures allow us to interpret more accurately the selective action of predators on various prey species, their relative dependence on them, and the ratios of prey species. They allow us to check the damage done by individuals of one species against good done by those of another.

Such calculations or estimates may be derived in a vague way from volumetric studies of stomach contents but only to the extent in which the volume of individuals of prey species is known and compared. Even then differential digestion obscures the estimates.

Let us select as an example one individual of the small short-tailed shrew, *Cryptotis parva*, trapped at Champaign, Illinois in December, 1934. Omitting a frequency

analysis of the stomach contents, let us illustrate the advantages of a prey-individual analysis over those of a volumetric analysis.

The individual had ranged over ground sparsely covered with a grass of the genus *Sporobolus* in which estimate disclosed about 169 hibernating chinch bugs, *Blissus leucopterus*, per square meter. Volumetric analysis showed that about 50 per cent of the food in its stomach was chinch bug and 50 per cent was spider. We learn more or less exactly the species eaten but how are we to do more than guess at the economic gain or loss from this meal, or even of a large number of meals? Damage by, and worth of, animals are calculated on the basis of numbers, not volume.

Prey individual analysis shows that this shrew had consumed five chinch bugs and one spider, a ratio of five to one. We learn as much as we did above and have figures for any calculations we may wish to make. Assuming that the spider was beneficial, we may calculate the worth of the meal by use of figures on destructiveness of individual chinch bugs. These chinch bugs could have ruined a stalk of wheat, and their progeny could have ruined a stalk of corn. The point is that this numerical method of analysis is relatively exact, capable of extension, and quickly translatable into other values because it is expressed in a universal language.

Good analyses (1) give the scientific name of the predator species, for even closely related species differ widely in habit; (2) give, as nearly as possible, the scientific name of the prey species eaten; (3) give as accurately as possible the number of individuals of each; (4) give place and date of collection. They might also very well define the habitat from which the predator was collected, especially from the standpoint of the number of individuals and ratio of prey species available. Berries and seeds may be analysed by number, but most vegetable material, carrion, and inorganic material may be analysed by bulk or frequency and compared with the total bulk of the other food items.

The bearing of the above remarks may be made clearer by the following examples of numerical and habitat-definition studies: Elton, "The numbers of animals," Animal Ecology, pp. 101–126, 1927; Errington, "Food habits of southern Wisconsin raptors," Condor, vol. 34, no. 4, pp. 176–186, July, 1932; Forbes, "The regulative action of birds upon insect oscillations," Illinois State Laboratory of Natural History, Bull. 6, pp. 32, May, 1883; Leopold, "Predator control," Game Management, 1933; and Chapman, "The quantitative analysis of environmental factors," Ecology, vol. 9, no. 2, pp. 111–122, April, 1928.—Carl O. Mohr, *State Natural History Survey, Urbana, Illinois.*

A PREDATORY SQUIRREL

Numerous rodents, including the squirrels, are known to indulge in various digressions from a strictly vegetarian diet. These digressions are, however, commonly restricted to consumption of the invertebrates or of the eggs, the helpless young, or the dead carcasses of the vertebrates. I was therefore surprised to find an apparent case of true predatory behavior in the ground squirrel (*Otospermophilus grammurus*) of Arizona. On June 29, 1934, I was following an old trail through open forest in the Chiricahua Mountains of Arizona at 8,000 feet elevation, when I heard the frenzied screeching of western robins (*Turdus migratorius propinquus*) from the neighborhood of a fallen log some yards distant. Suspecting either a weasel or a snake as the stimulus, I ran to the spot and was surprised to see as I rounded the log a ground squirrel holding a female robin in its mouth and braving the fluttering attack of the male bird. The squirrel was but ten feet distant and was startled into dropping its prey. It ducked under the log and raced for a rock pile fifty yards away with the male bird making repeated dashes at its back. My snap shot was so poor that I failed to stop the squirrel, but slew poor Cock Robin. Picking up the female where it had been dropped beside the log, I found it completely lifeless with fresh blood flowing from a wound in the breast at the base of

the neck. The squirrel held its prey well off the ground when I first saw it; the carcass was perfectly fresh and warm when examined later. The male bird was frenzied in its attack and followed the predator for twenty yards as it ran away. I can see no satisfactory explanation except that the squirrel had captured and killed an adult and free bird in a truly predatory act.—LOYE MILLER, *University of California at Los Angeles.*

BREEDING SEASONS OF GRAY SQUIRREL AND FLYING SQUIRREL

In fire hazard reduction work carried on under ECW in Mammoth Cave National Park (proposed) in Edmonson County, Kentucky, most of the dead trees (mainly chestnut) are being cut. An effort is made to spare den trees and those used as perches by birds; but a number of trees containing young squirrels have been felled. This has made possible the following observations on the litters of the gray squirrel and of the flying squirrel over the period from June 1, 1934 to April 15, 1935.

Records of gray squirrel (Sciurus carolinensis carolinensis Gmelin)

DATE	NUMBER OF YOUNG IN LITTER	STAGE OF DEVELOPMENT
Aug. 3, 1934	1	Without hair.
Aug. 6, 1934	3	Without hair.
Aug. 6, 1934	3	Furred, eyes closed.
Aug. 20, 1934	2	118 and 120 mm. long.
Aug. 24, 1934	2	Furred, eyes closed.
Sept. 6, 1934	3	Eyes closed.
Sept. 7, 1934	3	Eyes closed.
Sept. 12, 1934	3	Eyes closed.
Sept. 12, 1934	2	Eyes closed.
Sept. 13, 1934	3	Eyes open.
Sept. 17, 1934	3	Eyes barely open.
Sept. 17, 1934	2	Eyes barely open.
Sept. 20, 1934	4	One-fourth grown.
Sept. 21, 1934	3	Able to climb.
Sept. 24, 1934	3	One-fourth grown.
Sept. 24, 1934	3	One-fourth grown.
Feb. 14, 1935	2	Approximately 1 day old.
Feb. 14, 1935	2	Approximately 1 day old.
Feb. 15, 1935	4	Approximately 5 days old.
Feb. 18, 1935	2	Approximately 3 days old.
Feb. 19, 1935	2	Eyes closed.
Feb. 20, 1935	2	Eyes closed.
Feb. 27, 1935	3	Eyes closed.
Feb. 27, 1935	2	Approximately 2 days old.
Feb. 28, 1935	4	Approximately 2 days old.
Feb. 28, 1935	2	Eyes closed.
Mar. 3, 1935	1	One-third grown.

During October, no young squirrels were found in the nest, with the exception of those large enough to care for themselves. The young squirrels observed from March 15 to April 15 were all able to climb and in most cases were old enough to care for themselves.

These observations indicate that fall litters average larger than the spring litters and that there are two distinct annual birth periods.

Records of eastern flying squirrel (Glaucomys volans volans (Linnaeus))

DATE	NUMBER OF YOUNG IN LITTER	STAGE OF DEVELOPMENT
Aug. 22, 1934	4 embryos, 65 mm. long	Female's nest contained 4 young, two-thirds grown but weaned.
Sept. 11, 1934	3 young	Eyes closed.
Sept. 14, 1934	4 young	Eyes closed.
Sept. 18, 1934	3 young	Eyes closed.
Sept. 18, 1934	3 young	Eyes closed.
Mar. 11, 1935	2 young	Approximately 1 day old.
Mar. 12, 1935	3 young	Approximately 2 days old.
Apr. 2, 1935	2 young	Eyes open.
Apr. 4, 1935	3 young	Eyes closed.

The flying squirrel is not as abundant in this area as is the gray squirrel, but sufficient records have accumulated to indicate that adult females of both species produce two litters a year in Kentucky, and that the young gray squirrels are born in August and February, while the young of the flying squirrel are produced in September and March.—CLAUDE W. HIBBARD, *Resident Wildlife Technician, National Park Service, Mammoth Cave, Kentucky.*

BONE CACHE OF A GRAY SQUIRREL

While making a wild life census in the Coon Creek area, Vernon Co., Wisconsin, September 22, 1934, I observed an interesting action on the part of a gray squirrel, *Sciurus carolinensis leucotis*, that seems worthy of record.

The squirrel, when I first saw it, was about fifty feet from me and was engaged in burying an acorn. After finishing that job he climbed a small soft maple about thirty feet away and ran out on one of the larger branches. This branch had been broken near the end, and in it was a small cavity, apparently about as big around as the squirrel's head. From the cavity the squirrel drew out an object about seven inches long, which I took to be a stick. He gnawed it for a few seconds, until I frightened him into dropping it. To my surprise, the object proved to be the rib of a fox or small dog. It was much weathered, and in addition to the fresh toothmarks, it bore the marks of numerous earlier gnawings. As far as I could judge from appearances the older marks had been made at various times, as if the cached bone had been used repeatedly.—PHILIP F. ALLAN, *Soil Erosion Service, Caledonia, Minnesota.*

THE NAME SALAMANDER FOR THE POCKET GOPHERS

Not only is the name "salamander" applied to the tailed amphibians but, in the southeastern United States, to the pocket gophers as well. The origin of the term's application to the tailed amphibians is given by Dunn (1926, The salamanders of the family Plethodontidae, Publ. Smith College, Northampton, Mass., p. 1) and to the pocket gophers by Merriam (1895, Monographic revision of the pocket gophers, North Amer. Fauna no. 8, p. 118) who quotes Goode's hypothesis (1875, Notes on the "salamander" of Florida (*Geomys tuza*), in John W. Powell, Explor. Colorado River of the West, 1869–1872, pt. 3, Zoology, Addendum B, p. 281). Both of these explanations refer to the association of these animals with fire. Goode believed that "salamander" was an appropriate name for the pocket gopher because of this little fellow's activity in the ashes of recent forest fires. The following incident may offer another interpretation on why pocket gophers are called "salamanders" in the South.

In a recent conversation with an old colored woman, born a slave on a plantation in south Georgia, the word "salamander" was used. The old woman recognized the term to apply to the pocket gopher but when she repeated the term she said "sandy-mounder" instead of "salamander." Further questioning revealed that "sandy-mounder" was the name applied by the old negroes to the pocket gopher and that the terms "salamander" and pocket gopher were unknown to them.

The old woman's pronunciation of "sandy-mounder" was much like that of "salamander." Since the pronunciation of the two terms are similar it is possible that the descriptive term "sandy-mounder" was interpreted as "salamander" by people familiar with the latter term.—JOHN D. KILBY, *Department of Biology, University of Florida, Gainesville, Florida.*

STRANGE HABITAT OF THE DESERT WOOD RAT

On December 5, 1934, Joseph Dixon, Donald Curry, of the National Park Service, and the writer, stopped to examine a small salt marsh at an elevation of 100 feet on the east side of Death Valley, California, 40 miles by road south of Furnace Creek Ranch.

Here we found runways cut through the grass, salt bushes, and cane. Many of the runways led through shallow water and some were as much as fifty feet from the nearest dry ground. On the evening of December 5, the writer placed twelve rat traps in these runways and baited them with rolled oats. In spite of the fact that it rained steadily most of the night, six adult woodrats (*Neotoma lepida lepida*) were found in the twelve traps the following morning. One specimen was lying in shallow water where it had been trapped.

This animal lives commonly among the mesquite trees throughout the Death Valley region and is usually considered an inhabitant of the dry desert areas. There appears to be no other record of the desert woodrat's making its home in a salt marsh. It has been the writer's experience that woodrats usually do not live in colonies.

Five of the six specimens were preserved as study skins and identified at the Museum of Vertebrate Zoology, Berkeley, California. No difference in coloring between the marsh-taken specimens and a large series of specimens from the desert areas of the Death Valley region could be detected.—A. E. BORELL, *Wildlife Division, National Park Service, U. S. Department Interior.*

STATUS OF THE MINNESOTA CARIBOU

It is common knowledge in the region that a few woodland caribou, supposedly *Rangifer caribou sylvestris* (Richardson), still maintain themselves in the muskeg country lying between Upper Red Lake and Lake of the Woods in northwestern Minnesota. The exact number of animals in this band of survivors has frequently been estimated but never accurately determined. The following data are not given as a complete census but simply as some definite figures regarding these survivors.

A party consisting of C. M. Aldous, Regional Biologist for the U. S. Biological Survey, Charles McFarlane, Deputy State Commissioner of Game and Fish, State Wardens Charles Masoner, William Carlson, and Fred Petroske, and the writer spent the period from February 28 to March 3, 1935, inclusive, investigating the status of this caribou herd. On March 1 three adult animals were approached within one hundred and fifty yards. One of these had retained its antlers, which were about sixteen inches in length. Two of the wardens, while circling these three, sighted two other adults in the distance. Fresh tracks belonging apparently to a yearling calf were found. It is highly improbable, of course, that all the members of the band were recorded on this trip. However, these combined observations make certain of a present population of at least six animals. Other small bands may exist in other parts of this extensive muskeg country but resident

wardens and trappers are of the opinion that these are the last of the species in the region.—W. J. Breckenridge, *Museum of Natural History, University of Minnesota, Minneapolis, Minn.*

BODY TEMPERATURES OF SLOTHS, ANTEATERS, AND ARMADILLOS

One of us published recently a review which discussed the location of the testes in relationship to body temperature in mammals. (Wislocki, 1933, Quart. Rev. Biol., vol. 8, pp. 385-396.) Data on rectal temperatures of the Xenarthra were available for sloths (Bradypodidae) and armadillo (Dasypodidae), but no information existed at the time for the third group comprising this order, the anteaters (Myrmecophagidae). The group Xenarthra consists of animals possessing permanent intra-abdominal testes and for this reason their body temperatures might be expected to be low. This proved to be the case upon examination of sloths and armadillos; nevertheless, the sloths had much lower and more fluctuating temperatures than the armadillos—a circumstance which suggested that the sluggish mode of life of the sloths might be an additional contributing factor to their extremely low temperatures. We have now at our disposal temperature readings for the anteaters, namely the giant anteater (*Myrmecophaga jubata*), the three-toed anteater (*Tamandua tetradactyla*), and the two-toed anteater (*Cyclopes didactylus*). Of these three animals, the small arboreal *Cyclopes* is exceedingly sluggish, resembling in this respect the sloths more nearly than the other anteaters.

The temperatures which we have assembled for the various representatives of the Xenarthra may be briefly summarized as follows:

	RANGE OF AIR TEMPERATURE	RANGE OF RECTAL TEMPERATURE
Dasypus novemcinctus	5° to 30°C.	30° to 35°C.
	24° to 30°	33° to 35°
Myrmecophaga jubata	16° to 21°	32° to 34°
Tamandua tetradactyla	25°	33.7°
	27.2°	34°
	27.6°	34.6°
Cyclopes didactylus	23.3°	28.9°
	26.7°	31.3°
Bradypus tridactylus	19° to 25.8°	30° to 32.9°
Bradypus cuculliger	24.5° to 32.4°	27.7° to 36.8°
Bradypus griseus	13° to 26°	24° to 33°

The data for *Dasypus* and *Bradypus* are summaries taken from the review published previously (Wislocki, 1933). The readings for *Myrmecophaga jubata* were obtained from a six-months old animal, in every respect in excellent physical condition, brought from Brazil by Dr. G. W. D. Hamlett. Its rectal temperature was taken on eight occasions in the afternoon at room temperatures ranging from 16 to 21 degrees centigrade. The temperatures of *Tamandua* and *Cyclopes* were recorded by one of us (R. K. E.) on a recent trip to Panama. The readings were all taken by rectum and are presented in centigrade.

Our observations reveal that the sloths, anteaters and armadillos all possess extremely low body temperatures subject to wide latitude of fluctuation influenced by the temperature of the environment. The armadillo (*Dasypus novemcinctus*), tested over a wide range of external temperatures (5 to 30 degrees), fluctuated between body temperatures of 30 to 35 degrees; the three-toed sloth (*Bradypus*), tested within a somewhat

smaller range (13 to 32 degrees), showed as much as 12 degrees difference between maximum and minimum readings. The mean temperature of the sloth, moreover, is several degrees lower than that of the armadillo. The lowest and most labile temperatures recorded in mammals are found in the sloths and the monotremes. The less complete data for *Myrmecophaga* and *Tamandua* suggest that the temperatures of these animals are similar to those of the armadillo, whereas the two observations on the sluggish *Cyclopes* indicate that its body temperature is a few degrees lower, resembling that of the inactive sloth.—G. B. Wislocki and R. K. Enders, *Harvard Medical School and Swarthmore College.*

NEW MAMMAL RECORDS FOR MAMMOTH CAVE NATIONAL PARK, KENTUCKY

Little work has been done on the mammals of Kentucky and it seems that the following new records of species occurring in the Mammoth Cave National Park area will help to fill in distributional gaps. The reported forms are represented in the Park collection by skins and skulls.

Cryptotis parva (Say).—Little short-tailed shrew. This shrew was captured when a rotten log was moved during general cleanup around an abandoned farm site on the north side of Green River.

Reithrodontomys humulis merriami (Allen).—Merriam harvest mouse. An immature female was taken along the edge of an old field.

Peromyscus nuttalli nuttalli (Harlan).—Northern golden mouse. In a wooded area an adult male was taken from a dead snag in which its nest was built. This is the only specimen of this form observed during 10 months work.

Microtus pennsylvanicus pennsylvanicus (Ord).—Eastern meadow mouse. This meadow mouse is abundant, especially along grass fence rows and in abandoned fields overgrown by sedge grass.

Pitymys pinetorum auricularis (Bailey). Bluegrass pine mouse. This mouse is abundant in the wooded areas where bluegrass is found, and in the bottom of old sinkholes which have grown up to bluegrass.—Claude W. Hibbard, *Resident Wildlife Technician, National Park Service, Mammoth Cave, Kentucky.*

A PRACTICAL METHOD OF DEGREASING STUDY SKINS

In The Auk, vol. 52, no. 1, January, 1935, pp. 102–103, I described a method for degreasing bird skins that gives excellent results. This works just as well for mammal study skins. The procedure is as follows:

The specimen is skinned as usual and the fat carefully scraped from the skin, after which it is made into a completed skin and allowed to dry for several weeks. The fully prepared and labelled study skin (several may be degreased simultaneously) is then placed in a vat or wash-boiler containing several gallons of clear white gasoline such as is obtainable at most filling stations. It is allowed to remain here for several weeks during which period the skin is removed several times, drained, and placed in fresh gasoline. Finally it is removed and drained head downward for about an hour and then placed on a flat pile of newspapers which are allowed to soak up the gasoline. The papers are changed several times before the specimen is thoroughly dry. This completes the process.

Gasoline that has been used to degrease skins is strained and poured into the tank of the family automobile, thus reducing the cost of degreasing to almost nothing.

It is believed that this method is superior to that of degreasing freshly skinned specimens in gasoline (or other solvent) before making them up into study skins. Gasoline will not penetrate a fresh, wet skin nearly as well as it will a dry one, even though alcohol is added to increase miscibility.

In large greasy specimens it is desirable to drill holes into the larger bones so that the fat within may be more readily removed by the gasoline.

The only reference that I have found concerning the degreasing of made-up skins without relaxing them is a brief account by R. M. Anderson (Bull. 69, Biological Series no. 18, p. 105, National Museum of Canada) who quotes Wharton Huber as recommending the degreasing of small mammal skins without removing the stuffing by soaking in gasoline, after which the skin is dried in sawdust.

I can see no advantage in using sawdust or anything else to dry the skins since newspapers will soak up most of the gasoline and the rest evaporates. Further there is no advantage in restricting this method to small skins, since the results are equally satisfactory with large ones.

It should be emphasized that degreasing skins in gasoline is not a substitute for carefully scraping the fat from the inside before stuffing. Since it is impossible to remove all the fat by scraping alone the use of some fat solvent such as gasoline is necessary with fat specimens. The use of gasoline has the added advantage of making the skin less attractive to dermestids.

It should perhaps be pointed out that large quantities of gasoline should be used only with proper precautions against fire hazard. Such degreasing operations are best carried out in a small building at a safe distance from dwellings or other structures. Vats containing gasoline should, of course, be kept covered.—George E. Hudson, *Department of Zoology and Anatomy, University of Nebraska, Lincoln, Nebraska.*

RECENT LITERATURE

Maynard, L. A., Gardiner Bump, Robert Darrow, and J. C. Woodward. Food Preferences and Requirements of the White-Tailed Deer in New York State. Bull. no. 1, a Joint Contribution of the New York State Conservation Department and New York State College of Agriculture, pp. 35, figs. 4. January, 1935.

Under this title these investigators have made a contribution of major importance to the wildlife interests of our country. Their bulletin clearly and concisely gives the results of a well-planned and effectively-executed study of the nutritive requirements of the white-tailed deer and shows the value of various natural foods and of artificial foods appropriate for use in the wild. The object of the work was to develop a practical and economical method of preventing losses by starvation that normally occur in the mountains of New York during severe winters.

Because the carrying capacity of a given area, particularly the more northern forests and Mountainous areas where extreme cold and heavy snows occur, is largely based on the availability of the winter food supply, this contribution is of extreme importance and should afford a practical means of materially increasing the deer population. Benefits accruing to sportsmen, game commissioners, and wildlife interests in general from this research undoubtedly will be considerable.

The work consisted of both field experimentation, under conditions simulating those in the wild, and detailed laboratory research. These investigations showed that white cedar (*Thuja occidentalis*), black birch (*Betula lenta*), yellow birch (*B. lutea*), staghorn sumac (*Rhus typhina*), sweetfern (*Myrica asplenifolia*), witch hobble (*Viburnum alnifolium*), and many species of ferns are the preferred though not exclusive natural foods occurring in this area. It is somewhat surprising to find the apple (*Malus* spp.), mountain ash (*Sorbus americana*), white birch (*Betula alba* var. *papyrifera*), and buckbrush (*Viburnum cassinoides*) classed in the second choice group of browse. It was equally surprising to find that aspen twigs (*Populus tremuloides*), willow

(*Salix* spp.), and oak leaves (*Quercus* spp.) were found to be among the less desirable plant foods. The plants in the first list seem adequate to maintain the animals in satisfactory weight and vigor during the winter. It was found that while alfalfa hay was fairly acceptable and that it would keep the animals in nearly as good condition as the best of browse, it was too expensive and bulky to transport in sufficient quantity to deer concentration points in the more inaccessible mountainous areas. Marsh hay (unfortunately the authors did not state which of the various kinds they tested) was found to be practically worthless as a winter food. It was found that, while balsam (*Abies balsamea*) was readily acceptable as a food, it alone would not sustain the animals in normal health. Consequently it was concluded that the plant was worthless as a food. To the reviewer it seems more probable that it lacked certain necessary nutrients and in proper combination may be a desirable article of diet. A single food rarely affords a balanced diet.

After considerable experimentation and testing, the authors developed a comparatively inexpensive and otherwise satisfactory food consisting of 45 per cent by weight of cane molasses and 55 percent of coarsely ground soy beans. This was prepared and distributed in the form of 25 or 50 pound cakes, put up either in wire netting for immediate attachment to tree trunks or hermetically sealed for deferred use. It was at first found necessary to use browse to cover the cake to induce the deer to eat the new and strange food. Once started they ate it avidly. A 50-pound cake was found to last eight deer nearly two weeks under average conditions. Unfortunately the workers do not discuss the costs of preparing this artificial food nor point out many of the economic aspects involved in its use. It should be considered solely an emergency food, and its possible ill effects on the teeth should be carefully watched for.

It would seem probable that this or a similar preparation might be suitable for other varieties or species of deer, elk, and perhaps other big game animals of the West where acute winter-feeding problems develop. The workers also found that when snow is on the ground little or no water is needed by the deer.

In addition to a consideration of these practical food problems, a more or less detailed study was made of various physiological reactions, nitrogen balance, blood composition, and blood counts.

While the results are of very great importance, it seems to the reviewer that in some instances too few specimens of deer were used for this study to warrant the drawing of general conclusions.—Clarence Cottam.

Abbie, A. A. The brain-stem and cerebellum of *Echidna aculeata*. Philos. Trans. Roy. Soc. London, ser. B., vol. 224, no. 509, pp. 1–74, figs. 1–22. October 30, 1934.

Abe, Y. On the Amami spinous rat (*Rattus jerdoni osimensis* subsp. nov.), with special remarks upon its spines. Journ. Sci. Hiroshima Univ., ser. B, div. 2, vol. 3, pp. 107–114, pl. 1. December, 1934.

Abel, Othenio. Wesen, Aufgaben und Ziele der Paläobiologie. Der Biologie, München, Jahrg. 1, no. 12, pp. 259–263. September, 1932.

Abel, Wolfgang. Beiträge zur Kenntnis der Anpassungserscheinungen der distalen Hinterfussmuskulatur der Säugetiere bei einem Wechsel der Lebensweise. Gegenbaurs Morphol. Jahrbuch, Leipzig, vol. 64, nos. 3–4, pp. 558–635, figs. 40. July, 1930.

Adloff, P. Über die Zahnentwicklung des Pferdes. Bemerkungen zu der gleichnamigen Arbeit von F. Moser. Gegenbaurs Morphol. Jahrbuch., Leipzig, vol. 73, pp. 446–450, figs. 3. April, 1934.

——— Das Tuberculum molare des ersten Milchmolaren und die tubercula paramolaria der Molaren des Menschen nebst einigen Bemerkungen zur Abstam-

mungsfrage. Anat. Anz., vol. 78, nos. 15–19, pp. 342–351. August 30, 1934. (Concludes (p. 349) that the hominids have always been hominids, never anthropoids.)

AIRAGHI, CARLO. Mammiferi del Quaternario di Zandobbio presso Trescorre Balneario (Prov. di Bergamo). Natura, Milano, vol. 25, fasc. 2, pp. 63–67, figs. 2. 1934.

ALCORN, GORDON D. Unusual home of beaver. Murrelet, vol. 15, no. 3, p. 82. September, 1934. (In a mine tunnel in Blewitt Pass, Washington.)

ALEKSEEV, A. K. Die obersarmatische Säugetierfauna von Eldar. Pt. I. Achtiaria borissiakii n. sp. Trudy Geologicheskogo Muzeia Akademii Nauk SSSR (Trav. Mus. Géol. Acad. Sci. URSS.), vol. 7, pp. 167–204, figs. 6, pls. 5. 1930. (In Russian, with German summary; new: *Achtiaria borissiakii*.)

ALLANSON, M., AND R. DEANESLY. The reaction of anoestrous hedgehogs to experimental conditions. Proc. Roy. Soc. London, ser. B., vol. 116, no. 797, pp. 170–185. October 1, 1934.

ALLANSON, M., I. W. ROWLANDS, and A. S. PARKES. Induction of fertility and pregnancy in the anoestrous ferret. Proc. Roy. Soc. London, ser. B., vol. 115, no. B 795, pp. 410–421, pls. 17–18. August 1, 1934.

ALLEN, E. ROSS. Capturing a panther. Florida Conservator, Tallahassee, vol. 1, no. 6, pp. 3–4, 10–11, illus. December, 1934. (*Felis concolor coryi*.)

AMON, RUDOLF. Säugetierfährten aus dem Rohrbacher Konglomerat. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 40–42. December 31, 1933.

ANDREEWA, A. Über den Bau des Metacarpus bei *Equus prezewalskii*. Abstr. works zool. inst. Moscow State Univ., pp. 105–107. 1933. (In Russian.)

[ANONYMOUS] Canada's fur bearers, containing notes on the principal fur bearing animals of Canada, trapping and the preparation of furs for the market. Hudson's Bay Company: Winnipeg, pp. 63, map, illus. 1933.

——— Life history and habits of the muskrat. Maryland Conservationist, vol. 11, no. 4, pp. 1–4, 21–26, fig. 1. 1934.

ANTHONY, H. E., and G. H. H. TATE. Notes on South American mammals. No. 1. *Sciurillus*. Amer. Mus. Novitates, no. 780, pp. 11, figs. 6. February 14, 1935.

ANTONIUS, OTTO. Über einen Pferdeschädel aus dem Rancho La Brea. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 39–40. December 31, 1933.

ATKINSON, AGNES AKIN. Our friend, the ring-tail. Nature Mag., vol. 24, no. 3, pp. 110–112, illus. September, 1934. (*Bassariscus*.)

AVINOFF, ANDREY. The giant sable antelope. Carnegie Mag., Pittsburgh, vol. 7, no. 3, pp. 82–83, illus. June, 1933.

BACKMAN, GASTON. Das wachstum der Körper-länge des Menschen. Kungl. Svenska Vetensk. Akad. Handlingar, vol. 14, no. 1, pp. 1–145, figs. 25. 1934.

BAKALOV, PETER. Die Hipparionenfauna von Kalimanci und Kromidovo, Bezirk Sweti Wrač, Südwest-Bulgarien (II. Primates-Anthropoidea-Cynopithecidae). Geol. Balkanica, Sofia, vol. 1, pt. 1, pp. 17–24, pls. 6–8, 1934. (*Mesopithecus pentelicus* Wagner, photographs of skull and teeth; in Bulgarian, with German summary.)

BALSAC, H. HEIM DE. Note complémentaire sur les Damans de l'Haggar. Bull. Mus. Nat. Hist. Nat., Paris, ser. 2, vol. 6, no. 3, pp. 224–227. April, 1934. (*Procavia*.)

——— Mission Saharienne Augiéras-Draper 1927–1928. Mammifères. Bull. Mus. Nat. d'Hist. Nat., Paris, ser. 2, vol. 7, no. 6, pp. 482–489. November, 1934. (New: *Rhinolophus acrotis schwarzi*.)

BANZHAF, W. Missbildungen des Gebisses bei Nagetieren. Natur und Volk (Nat. u. Mus.), Frankfurt a. M., vol. 64, no. 8, pp. 315–318, figs. 4. August 1, 1934.

BARBOUR, ERWIN HINCKLEY, and C. BERTRAND SCHULTZ. A new antilocaprid and a new cervid from the late Tertiary of Nebraska. Amer. Mus. Novitates, no. 734, pp. 4, fig. 1. August 3, 1934. (New: *Proantilocapra, P. platycornea, Dromomeryx trigonocorneus.*)

BARCLAY, EDGAR N. The elk of Siberia. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 14, no. 82, pp. 447–448. October, 1934. (On the basis of the characters originally assigned to it *Alces bedfordiae* Lydekker "can hardly be regarded as entitled to distinction.")

——— The red deer of the Caucasus. Proc. Zool. Soc. London for 1934, pt. 4, pp. 789–798, figs. 5, pls. 3. January, 1935. (*Cervus elaphus* subsp.)

BEAUX, OSCAR DE. Lo Stambecco della Colonia Eritrea. Rassegna Economica delle Colonie, Roma, Anno, 13, nos. 9–10, pp. 5–15. September-October, 1934. (*Capra nubiana* Cuvier.)

[BERGER, A. KATHERINE]. The Isle Royal moose herd. Natural History, New York, vol. 34, no. 7, p. 678. November, 1934.

——— Moose and wapiti in the western United States. Natural History, New York, vol. 34, no. 8, p. 763. December, 1934.

BEST, M. G. S. "Loch Ness monsters" at their source. Where the grey seals are born. Field, London, vol. 163, no. 4232, p. 219, illus. February 3, 1934.

BEVERIDGE, GEORGE. The hare in North Uist. Scottish Nat., no. 208, p. 94. July–August, 1934. (*Lepus europaeus occidentalis* and *L. timidus scoticus*, both introduced.)

BHADIAN, C. A. R. Notes on the swamp deer (*Rucervus duvaucelli*) in Assam. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 2, p. 485. August 15, 1934.

BIERENS DE HAAN, J. A., and J. TH. MEYKNECHT. Dressurversuche an einem stark motorischen Affen. Biol. Zentralbl., Leipzig, vol. 54, nos. 3–4, pp. 185–195. 1934. (*Cercocebus "fuliginosus" = atys.*)

BLACK, DAVIDSON. Recent discoveries at Choukoutien. Upper Palaeolithic culture in "Upper Cave" sediments. Nature, London, vol. 133, no. 3351, pp. 89–90. January 20, 1934. (Records occurrence of *Hyaena, Felis tigris, Cynailurus, Viverra, Equus hemionus, Cervus elaphus*, and *Cynocephalus cf. wimani.*)

BODE, FRANCIS D. The fauna of the Merychippus zone, North Coalinga district, California. Publ. 453, Carnegie Inst. Washington (Contrib. Paleont.), pp. 65–96, figs. 10, pls. 2. July 20, 1935.

BÖKER, HANS. Umweltänderung und Artumwandlung bei brasilianischen Säugetieren. Naturwiss., Berlin, vol. 20, no. 12, pp. 201–205. March 18, 1932.

——— Beobachtungen und Untersuchungen an Säugetieren während einer biologisch-anatomischen Forschungsreise nach Brasilien im Jahre 1928. Gegenbaurs Morphol. Jahrbuch, Leipzig, vol. 70, pp. 1–66, figs. 42. April, 1932.

BORISSIAK, A. Eine neue Rasse des Höhlenbären aus den quartären Ablagerungen des Nordkaukasus. Trav. Inst. Paléozool. Acad. Sci. USSR, Leningrad, vol. 1, pp. 137–202, pls. 7. 1932. (In Russian, with German summary. *Spelaearctos spelaeus rossicus*, not new here; previously described as *Ursus spelaeus rossicus* by Borissiak, 1930, Comptes Rendus Acad. Sci. URSS., ser. A, vol. 5, p. 102.)

BOYDEN, ALAN. Precipitins and phylogeny in animals. Amer. Nat., vol. 68, no. 719, pp. 516–536. November, 1934.

BRADLEY, O. CHARNOCK. M. retractor bulbi (oculi) in Carnivora and Ungulata. Journ. Anat., Cambridge, vol. 68, pt. 1, pp. 65–68, figs. 3–12. October, 1933.

BRAZENOR, C. W. Field notes on the yellow-bellied flying phalanger. *Petaurus australis* Shaw. Australian Zoologist, Sydney, vol. 8, no. 1, pp. 54–55, pl. 1. May 9, 1934.

BREUER, RICHARD. Merkwürdige Ausschliffe und deren Entstehung an Zähnen spelaeoider Bären. Palaeobiologica, vol. 6, no. 1, pp. 59–64, pl. 6. 1934.

BRODY, S. Preliminary investigation concerning the representation of the fovea in the external geniculate body of the monkey. Proc. Kon. Akad. Wet. Amsterdam, vol. 37, no. 9, pp. 724–731, figs. 9, pls. 4. November, 1934.

BROOM, R. On the fossil remains associated with *Australopithecus africanus*. South African Journ. Sci., vol. 31, pp. 471–480, figs. 7. November, 1934. ("With the exception of the land crab, all the identifiable species of animals in the Taungs deposit belong to extinct species," p. 479.)

BURBANK, R. C., and J. Z. YOUNG. Temperature changes and winter sleep of bats. Journ. Physiol., London, vol. 82, no. 4, pp. 459–467. November 12, 1934. (*Rhinolophus*, *Nyctalus* and *Pteropus*.)

BÜRGH, HANS. Morphologische und funktionelle Analyse der Wirbelsäule des Höhlenbären I. Palaeobiologica, vol. 6, no. 1, pp. 65–110, figs. 1–7, pls. 7–8. 1934.

BUTCHER, EARL O. The hair cycles in the albino rat. Anat. Record, vol. 61, no. 1, pp. 5–14, pls. 1–2. December 25, 1934.

CABRERA, ANGEL. Dos nuevos micromamíferos del Norte Argentino. Notas prelim. Mus. de La Plata, vol. 3, no. 1a, pp. 123–128, fig. 1. May 28, 1934. (New: *Graomys hypogaeus*, *Marmosa janetta pulchella*.)

CHAMPION, F. W. The preservation of wild life in India. No. 4. The United Provinces. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 1, [suppl.], pp. 105–111. April 15, 1934.

CHAPMAN, LUCIE, and WENDELL CHAPMAN. Beaver. Natural History, New York, vol. 34, no. 6, pp. 554–566, illus. October, 1934.

CHAPMAN, WENDELL. Bears will be boys. Nature Mag., vol. 24, no. 3, pp. 103–107, illus. September, 1934.

CHASEN, F. N. Notes on Echinosorex gymnurus (Raffles). Bull. Raffles Mus., Singapore, Straits Settlements, no. 9, pp. 86–89. December, 1934.

CHAWORTH-MUSTERS, J. L. A note on the nomenclature of the species of the "subtilis" group of the genus Sicista. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 14, no. 83, pp. 554–556. November, 1934. (Recognizes six races of *Sicista subtilis*.)

CLARKE, R. C. Notes on birth of a chimpanzee in the Clifton Zoological Gardens, Bristol. Proc. Zool. Soc. London for 1934, pt. 4, pp. 731–732. January, 1935.

CLODIUS, [G.] Ein Biber in Mecklenburg. Archiv. Ver. Freunde Naturgesch. Mecklenburg, Rostock, n.F., vol. 3, p. 62. (1927/28) 1928.

——— Der Hamster (*Cricetus frumentarius*) in Mecklenburg-Schwerin. Archiv. Ver. Freunde Naturgesch. Mecklenburg, Rostock, n.F., vol. 5, pp. 56–58. (1930) 1931.

COLBERT, EDWIN H. A new fossil peccary, *Prosthennops niobrarensis*, from Brown County, Nebraska. Nebraska State Mus., vol. 1, bull. 44, pp. 419–430, figs. 2. June, 1935. (New: *Prosthennops niobrarensis*.)

COUCH, LEO K. Chronological data on elk introduction into Oregon and Washington. Murrelet, vol. 16, no. 1, pp. 3–10, illus. January, 1935.

——— Additional elk planting information. Murrelet, vol. 16, no. 2, p. 42. May, 1935. (Into Wallowa National Forest, Oregon.)

COWAN, IAN MCTAGGART. Two cases of pathologic skin growths in deer of the genus *Odocoileus*. Murrelet, vol. 15, no. 3, pp. 81–82. September, 1934.

DAVIS, WILLIAM B. Mammals of the Ross Expedition (1824) in Idaho. Murrelet, vol. 16, no. 1, pp. 7–10. January, 1935.

DAWSON, WARREN R. Deer in ancient Egypt. Journ. Linnaean Soc. London, vol. 39, no. 264, pp. 137–145, illus. October 3, 1934. (Lists 18 pictures; probably *Dama mesopotamica*, captive or introduced.)

DITMARS, RAYMOND L., and ARTHUR M. GREENHALL. The vampire bat a presentation of undescribed habits and review of its history. Zoologica, Sci. Contrib. New York Zool. Soc., vol. 19, no. 2, pp. 53–74, fig. 3, pls. 5–7. April 3, 1935. (*Desmodus rotundus murinus* Wagner.)

DIXON, JOSEPH S. A study of the life history and food habits of mule deer in California. California Fish and Game, vol. 20, no. 3, pp. 181–282, figs. 47–111, July, 1934; no. 4, pp. 315–354, figs. 116–135, October, 1934. (Later reprinted and repaged in one brochure, for sale at 25 cents.)

DOBROVOLSKAIA-ZAVADSKAIA, N., N. KOBOZIEFF, and S. VERETENNIKOFF. Étude morphologique et génétique de la brachyourie chez les descendants de souris a testicules irradiés. Archiv. de Zool. Exper. et Générale, vol. 76, no. 4, pp. 249–358, figs. 25, pls. 8–11. February 15, 1934.

DOUHOVNY, M. M. Delphinapterus leucas in the Ob Bay. Abstr. works zool. inst. Moscow State Univ., pp. 79–82. 1933. (In Russian.)

DRÄSEKE, J. Zur macroskopischen Anatomie der Insektivoren mit vergleichend anatomischen Hinweisen. Anat. Anz., vol. 78, nos. 15–19, pp. 351–360, figs. 1–3. August 30, 1934.

DREYER, T. F., and ALICE LYLE. New fossil mammals and man from South Africa. Publ. Fort Hart Native College, Bloemfontain, pp. 60, figs. 12. 1931. (New: *Phacochoerus helmei, P. venteri, P. meiringi, P. dreyeri, Hippopotamus westphali, H. helmei, H. venteri, Equus lylei, E. westphali, E. helmei, E. kuhni simplex, Bubalis helmei, Aonyx robustus, Pedetes hagenstadi.*)

DYMOND, J. R. The white-tailed jack rabbit in Manitoba. Canadian Field-Nat., vol. 48, no. 6, p. 103. September, 1934.

EDSON, J. M. Yellow-bellied marmot at Bellingham, Washington. Murrelet, vol. 15, no. 3, p. 81. September, 1934.

EISENTRAUT, M. Fledermauszug und Fledermausberingung. Ornith. Monatsber., vol. 43, no. 1, pp. 22–25. January–February, 1935.

ELTON, CHARLES. The Canadian snowshoe rabbit enquiry, 1932–33. Canadian Field-Nat., vol. 48, no. 5, pp. 73–78, figs. 1–3. May, 1934.

FICK, RUDOLF. Untersuchungen an der Wirbelsäule der Menschenaffen. Sitz.-Ber. preuss. Akad. Wiss. phys.-math. Kl., Berlin, 1933, pp. 167–239, figs. 25. March 16, 1933.

FIGGINS, J. D. New material for the study of individual variation, from the Lower Oligocene of Colorado. Proc. Colorado Mus. Nat. Hist., vol. 13, no. 3, pp. 7–14, pls. 3. December 29, 1934. (Comments on characters of species of *Trigonias.*)

FINDLAY, G. M., and A. D. MIDDLETON. Epidemic disease among voles (*Microtus*) with special reference to *Toxoplasma*. Journ. Anim. Ecol., vol. 3, no. 2, pp. 150–160, pl. 7. November, 1934.

FORSTER-COOPER, C. The extinct rhinoceroses of Baluchistan. Philos. Trans. Roy. Soc. London, ser. B, vol. 223, pp. 569–616, figs. 21, pls. 64–67. August 1, 1934. (New: *Aceratherium abeli, Paraceratherium* (?) *churlandensis.*)

FRASER, F. C. Report on Cetacea stranded on the British Coasts from 1927 to 1932. No. 11, Brit. Mus. (Nat. Hist.), London, pp. 41, figs. 8, maps 6. August 18, 1934.

FREND, G. V. R. Hoof disease in the muntjac (*Muntiacus muntjac*). Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, p. 726. December 15, 1934.

FREUND, LUDWIG. Cetacea. In G. Grimpe and E. Wagler: Die Tierwelt der Nord- und Ostsee, Leipzig, Leif. 22, vol. 12, pt. 12, k_1, pp. 1–64, figs. 57. 1932.

GALLI-VALERIO, B. L'os pénien dans la classification zoologique. Schweizer Archiv. Tierheilk., Zürich, vol. 74, no. 4, pp. 193–195, 1 fig. April, 1932.

GATUEV, S. A. Indricotherium asiaticum Boriss. and its taxonomic position. Bull. Soc. Nat. Moscou, sect. géol., vol. 11, no. 2, pp. 181–192. 1933. (In Russian.)

GAZIN, C. LEWIS. A marsupial from the Florissant beds (Tertiary) of Colorado. Journ. Paleont., vol. 9, no. 1, pp. 57–62, pl. 12. January, 1935.

——— A new antilocaprid from the upper Pliocene of Idaho. Journ. Paleont., vol. 9, no. 5, pp. 390–393, fig. 1. July, 1935. (New: *Ceratomeryx*, *C. prenticei*.)

GIMSON, C. Growth and shedding of antlers in the swamp deer (*Rucervus duvaucelli*) in Manipur State. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, p. 726. December 15, 1934.

GOODWIN, GEORGE G. Mammals collected by A. W. Anthony in Guatemala, 1924–1928. Bull. Amer. Mus. Nat. Hist., vol. 68, art. 1, pp. 1–60, pls. 5. December 12, 1934.

GRANDIDIER, G. Un rongeur nouveau de Madagascar: *Mus decaryi*. Bull. Mus. Nat. d'Hist. Nat., Paris, ser. 2, vol. 7, no. 6, pp. 478–481, figs. 3. November, 1934. (New: *Mus decaryi*.)

——— Deux nouveaux mammifères insectivores de Madagascar *Microgale drouhardi* et *M. parvula*. Bull. Mus. Nat. d'Hist. Nat., Paris, ser. 2, vol. 7, no. 6, pp. 474–477. November, 1934. (New: *Microgale drouhardi* and *Microgale parvula*.)

GRANGER, WALTER, and WILLIAM K. GREGORY. A revised restoration of the skeleton of Baluchitherium, gigantic fossil rhinoceros of central Asia. Amer. Mus. Novitates, no. 787, pp. 1–3, figs. 2. April 1, 1935.

GRAY, ROBERT W. Do whales descend to great depths? Nature, London, vol. 135, no. 3401, pp. 34–35. January 5, 1935. (Probably to 600 fathoms or more when harpooned.)

——— Do whales descend to great depths? Nature, London, vol. 135, no. 3417, pp. 656–657. April 27, 1935. (More evidence of deep diving.)

GREGORY, WILLIAM K. Some new models illustrating the evolution of the human dentition. Internat. Journ. Orthodontia & Dentistry for Children, St. Louis, vol. 20, no. 11, pp. 1077–1081. November, 1934.

——— Polyisomerism and anthropogeny. Human Biology, vol. 6, no. 4, pp. 632–636. December, 1934.

——— The origin, rise and decline of Homo sapiens. Scientific Monthly, vol. 39, pp. 481–496, figs. 18. December, 1934.

——— Building a super-giant rhinoceros. Natural History, New York, vol. 35, no. 4, pp. 338–343. April, 1935. (*Baluchitherium*.)

———, and MARCELLE ROIGNEAU. Introduction to human anatomy. Guide to Section I of the Hall of Natural History of Man. Publ. Amer. Mus. Nat. Hist., pp. 82, figs. 28. 1934.

GRINNELL, JOSEPH. A revised life-zone map of California. Univ. Calif. Publ. in Zool., vol. 40, no. 7, pp. 327–330, 1 map. January 16, 1935.

——— A way to "bring back" the native bighorn to the Yosemite. Sierra Club Bulletin, vol. 20, no. 1, p. 28–31, illus. February, 1935.

HAMMOND, J., and A. WALTON. Notes on ovulation and fertilization in the ferret. Journ. Exper. Biol., vol. 11, no. 3, pp. 307–319. July, 1934.

——— Pregnancy during the anoestrous season in the ferret. Journ. Exper. Biol., vol. 11, no. 3, pp. 320–325. July, 1934.

HATT, ROBERT T. Pangolins. An account of certain strange anteaters of Africa and Asia. Natural History, New York, vol. 34, no. 8, pp. 725–732, figs. 10. December, 1934.

HECK, LUTZ. Bericht über den Wisent-Schutzpark in Springe. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 97–120, pls. 4–9. March 1, 1932.

HELLER, FLORIAN. Die Wühlmäuse der Mosbacher Sande. Notizbl. Ver. Erdk. u. hess. geol. Landesanst. f. 1931–1932, Darmstadt, ser. 5, vol. 14, pp. 108–116, pl. 10. 1933. (New: *Pitymys schmidtgeni*, *Microtus subarvalis*.)

———— Über einige merkwürdige Knochenfunde aus der Petershöhle bei Velden in Mittelfranken. Palaeobiologica, vol. 6, no. 1, pp. 51–58, pl. 5. 1934.

HENCKEL, K. O. Zur Entwicklungsgeschichte des Fussskeletts von *Tarsius spectrum* L. Gegenbaurs morphol. Jahrbuch, Leipzig, vol. 64, pp. 636–650, figs. 9. July, 1930.

HEPTNER, WL. G. Notizen über die Gerbillidae (Mammalia, Glires). VIII. Gerbillidae der Kaukasusländer und der Kalmükensteppe. Folia Zoologica et Hydrobiologica, Riga, vol. 6, no. 2, pp. 179–268, figs. 2, pls. 7–11. October 10, 1934.

HERSH, A. H. Evolutionary relative growth in the titanotheres. Amer. Nat., vol. 68, no. 719, pp. 537–561. November, 1934.

HIGGINS, J. C. The game birds and animals of the Manipur State with notes of their numbers, migration and habits. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 2, pp. 298–309. August 15, 1934.

HILL, ELLA WILSON. Before winter came to Alaska. Scientific Amer., vol. 151, no. 6, pp. 290–292, illus. December, 1934. (Popular account of extinct mammals.)

HILL, JOHN ERIC. The retractor muscle of the pouch in the Geomyidae. Science, n.s., vol. 81, no. 2093, p. 160. February 8, 1935.

HILL, LEONARD. [Do whales descend to great depths?] Nature, London, vol. 135, no. 3417, p. 657. April 27, 1935. (No reason why whales should suffer from the troubles that affect divers and caisson workers. Not enough air in whale's lungs to produce bubbles of nitrogen in blood.)

HILL, W. C. OSMAN. The suprarenal cortex in monkeys of the genus *Pithecus*. Journ. Anat., Cambridge, vol. 68, pt. 1, pp. 19–38, figs. 1–8. October, 1933.

HIRASAKA, KYOSUKE. On the distribution of sirenians in the Pacific. Proc. 5th Pacific Sci. Congress, Canada, 1933, Univ. Toronto Press, pp. 4221–4222. 1934.

HJORT, JOHAN, and JOHAN T. RUUD. Whaling and fishing in the North Atlantic. Conseil Permanent Internat. Explor. Mer, Rapp. et Proc. Verb. Réunions, Copenhague, vol. 56, pp. 1–123, 24 maps, 35 figs. May, 1929.

HOERMANN, KONRAD. Die Petershöhle bei Velden in Mittelfranken, eine altpalaeolithische Station. Abhandl. naturhist. Ges. Nürnberg, vol. 24, no. 2, pp. 15–90, pls. 7–35. 1933. (List of mammals, p. 71.)

HORNBY, JOHN. Wild life in the Thelon River area, Northwest Territories, Canada. Canadian Field-Nat., vol. 48, no. 7, pp. 105–111. October, 1934.

HÜRZELER, J. Vorläufige Mitteilung zur Osteologie von *Caenotherium* Bravard. Eclogae Geologicae Helvetiae, Basel, vol. 26, no. 2, pp. 235–237. December, 1933.

INGEBRIGTSEN, ANDR. Whales caught in the North Atlantic and other seas. Conseil Permanent Internat. Explor. Mer, Rapp. et Proc. Verb. Réunions, Copenhague, vol. 56, pp. 1–26. May, 1929.

JACKSON, J. WILFRID. Lynx remains from Yorkshire caves. Naturalist, London, no. 891, pp. 115–116. April, 1931.

JOHNSTON, C. STUART. An extension in the range of fossil peccaries. Amer. Midland Nat., Notre Dame, vol. 16, no. 1, pp. 117–119, figs. 2. January, 1935. (*Mylohyus*.)

JOHNSON, MARTIN. Wings over Africa. An account of a photographic expedition that traveled by airplane through 60,000 miles of African sky. Natural History, New York, vol. 34, no. 7, pp. 597–611, illus. November, 1934.

JOLEAUD, L. Études de géographie zoologique sur la Berbérie. Les ruminants. V. Les gazelles. Bull. Soc. Zool. France, Paris, vol. 54, pp. 438–457. 1929.

JOLEAUD, L. A propos de la persistance tardive du *Dinotherium* et de la très grande ancienneté d'outillages et de restes d'*Homo sapiens* dans l'Afrique orientale. Bull. Soc. géol. France, Paris, ser. 5, vol. 1, Comptes Rendus somm. Seances, fasc. 17, pp. 275–276. December 21, 1931.

——— Découverte d'une vertèbre de Balénoptère à Quillebeuf (Seine-Inférieure). Bull. Soc. géol. Normandie et Amis du Mus. du Havre, vol. 36, pp. 25–26. 1933.

KAY, J. LEROY. The Tertiary formations of the Uinta Basin, Utah. Ann. Carnegie Mus., vol. 23, pp. 357–371, pls. 45–49. October 15, 1934. (Faunas listed in columnar section.)

KHOMENKO, I. P. Hyaena borissiaki n.sp. aus der Rusillon-Fauna Bessarabiens. Trav. Inst. paléozool. Acad. Sci. USSR, Leningrad, vol. 1, pp. 81–136, pls. 9. 1932. (In Russian, with German summary.) (New: *Hyaena borissiaki*.)

KHUDIAKOV, I. I., A. D. FURSAEV, A. I. KOSMINA, and E. P. MIKAILOVA. Food of *Citellus pygmaeus* and *C. fulvus* under natural conditions in western Kazakstan. Vestnik Mikrobiologii, Épidemiologii i Parazitologii (Rev. Microbiol., Épidémiol. et Parasitol.), vol. 12, no. 1, pp. 63–74. 1933. (In Russian, with German summary.)

KING, HELEN DEAN, and W. E. CASTLE. Linkage studies of the rat (*Rattus norvegicus*). Proc. Nat. Acad. Sci. Washington, vol. 21, no. 6, pp. 390–399. June, 1935.

KOENIGSWALD, RALPH VON. Die Bedeutung der Equiden für die Altersstellung des rheinhessischen Dinotheriensandes. Centralbl. f. Mineral., Jahrg. 1931, Abt. B, no. 1, pp. 42–48, fig. 1. November 10, 1930.

——— Sinanthropus, Pithecanthropus, en de ouderdom van de Trinil-lagen. Aanteekeningen bij de nieuwere literatuur over het Pithecanthropus-vraagstuk. De Mijinigenieur, Bandoeng, 12e Jaargang, no. 11, pp. 198–202. November, 1931.

——— Fossielen uit Chineesche Apotheken in West-Java. De Mijningenieur, Bandoeng, 12e Jaargang, no. 11, pp. 189–192, figs. 1–5. November, 1931.

KOENIGSWALD, G. H. R. VON. Metaschizotherium fraasi n.g.n. sp., ein neuer Chalicotheriide aus dem Obermiocän von Steinheim a. Albuch. Bemerkungen zur Systematik der Chalicotheriiden. Palaeontographica, Stuttgart, Suppl. vol. 8, pt. 8, pp. 24, fig. 1, pls. 3. 1932. (New: *Metaschizotherium, M. fraasi, M. bavaricum*.)

——— Zur Stratigraphie des javanischen Pleistocän. De Ingenieur in Nederlandsch-Indië, no. 11, pp. 185–201, pls. 3–4. 1934. (New: *Epimachairodus zwierzyckii, Sus coerti, Hippopotamus* (*Hexaprotodon*) *antiquus, Antilope modjokertensis, A. saätensis, Leptobos cosijni*.)

——— Die Spezialisation des Incisivengebisses bei den javanischen Hippopotamidae. Proc. Kon. Akad. van Wetenschap. Amsterdam, vol. 37, no. 9, pp. 653–659, figs. 7. 1934.

KÜTHE, KARLHEINZ. Sus scrofa Mosbachensis. Notizbl. Ver. Erdk. u. hess. geol. Landesanst. f. 1931–1932, Darmstadt, ser. 5, vol. 14, pp. 117–124, fig. 1, pl. 11. 1933.

LEONARD, A. B. Notes on larvae of Cuterebra sp. (Diptera: Oestridae) infesting the Oklahoma cottontail rabbit. Trans. Kansas Acad. Sci., vol. 36, pp. 270–274, illus. 1933.

LOEWENTHAL, N. De la différenciation d'une glande nyctitante vraie chez les Rongeurs. Bull. Histol. Appl. Physiol. et Path., Paris, vol. 10, no. 7, pp. 226–234, figs. 3. July, 1933.

LORENZO, GIUSEPPE DE, and GEREMIA D'ERASMO. Nuove osservazione sull'*Elephas antiquus* dell'Italia meridionale. Rend. Accad. Sci. fis. e mat. (Cl. Soc. R. Napoli), ser. 3, vol. 36, p. 143. 1931.

LOUKASHKIN, A. S., and V. N. JERNAKOV. The fur trade of North Manchuria. China Journ., vol. 21, no. 5, pp. 227–244, illus., November, 1934; no. 6, pp. 293–303, illus., December, 1934. (Lists 37 fur bearers, with the Chinese names.)

MACLEOD, JOHN. The part played by alternative hosts in maintaining the tick population of hill pastures. Journ. Anim. Ecol., vol. 3, no. 2, pp. 161–164. November, 1934.

MARSHALL, F. H. A., and F. P. BOWDEN. The effect of irradiation with different wavelengths on the oestrous cycle of the ferret, with remarks on the factors controlling sexual periodicity. Journ. Exper. Biol., Edinburgh, vol. 11, no. 4, pp. 409–422. October, 1934.

MATHEY-DUPRAZ, A. La Grotte aux ours de Montricher. Soc. neuchâteloise Sci. nat. (Bull. du Centenaire, Neuchâtel, pt. 2), vol. 57, pp. 201–202. (1932) 1933. (*Ursus arctos.*)

MATHIEU, M. G. Présentation d'ossements provenant d'un gisement Moustiérien à Origny-Benoite (Aisne). Soc. Géol. du Nord, Lille, vol. 57, pp. 36–37. 1932.

MCGREW, PAUL O. A new Cynodesmus from the lower Pliocene of Nebraska with notes on the phylogeny of the dogs. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, no. 10, pp. 305–312, figs. 4. March 15, 1935. (New: *Cynodesmus euthos.*)

MELNYK, O. Bisontina Osteuropas. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 169–176, pl. 14. March 1, 1932.

MERTENS, A. Ein alluvialer Wisentrest im Magdeburger Museum für Natur- und Heimatkunde. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 167–168, pl. 13. March 1, 1932.

MIDDLETON, A. D. Periodic fluctuations in British game populations. Journ. Anim. Ecol., vol. 3, no. 2, pp. 231–249. November, 1934.

MIRANDA-RIBEIRO, ALIPIO DE. On some foetal and post-foetal characters of mammals and birds; concerning scales, hairs, and feathers. Proc. Zool. Soc. London for 1934, pt. 3, pp. 573–582, pls. 1–4. September, 1934.

MONTEATH, G. The preservation of wild life in India. No. 2. The Bombay Presidency. Journ. Bombay Nat. Hist. Soc., vol. 36, no. 4, [suppl.], pp. 46–58. December 15, 1933

MORALES AGACINO, E. La distribución del *Eliomys lusitanicus* (Reuv.). Bol. Soc. Española Hist. Nat., vol. 34, no. 7, pp. 389–392, fig. 1. November 5, 1934.

MORRIS, R. C. Death of an elephant (*Elephas maximus* Linn.) while calfing. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, p. 722. December 15, 1934.

——— Death of 14 elephants (*Elephas maximus* Linn.) by food poisoning. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, pp. 722–723. December 15, 1934.

MOSER, FRITZ. Über die Zahnentwicklung beim Pferd. (Zahnstudie no. X). Gegenbaurs Morphol. Jahrbuch, Leipzig, vol. 73, pp. 238–256, figs. 8. December, 1933.

MOTTL, MARIA. Die Arctoiden und Spelaeoiden Merkmale der Bären. Földtani Közlöny, Budapest, vol. 63, nos. 7–12, pp. 165–177, figs. 53–75. 1933.

MULLER, JOHANNA. The orbitotemporal region of the skull of the Mammalia. Archiv. Néerlandaises de Zool., Leiden, vol. 1, nos. 1–2, pp. 118–259, figs. 114. 1934.

NAYAK, U. V. The articulations of the carpus in *Chiromys madagascarensis* with reference to certain other lemurs. Journ. Anat., Cambridge, vol. 68, pt. 1, pp. 109–115. October, 1933.

NEUVILLE, HENRI. Remarques à propos du développement des dents du cachalot (*Physeter macrocephalus* L.). Ann. Sci. Nat., Paris, ser. 10, Zool., vol. 18, pp. 171–195. 1935.

NICOL, THOMAS. Notes on irregularities of ovogenesis and abnormal development of the embryo in *Cavia*. Journ. Anat., Cambridge, vol. 68, pt. 1, pp. 75–84, pls. 1–3. October, 1933.

NIEZABITOWSKI, EDOUARD DE LUBICZ. Revue de la faune des mammifères en Pologne. Bull. Soc. Amis Sci. de Poznan, Sci. math. et nat., livr. 6, pp. 11. 1934. (New: *Mus spicilegus polonicus.*)

——— Bericht über die Säugetiere Polens und ihre geographische Verbreitung. Zeitschr. f. Säugetierkunde, vol. 9, pp. 188–197. December 30, 1934.

NOMLAND, GLADYS AYER. Proboscis statue from the Isthmus of Tehuantepec. Amer. Anthropol., vol. 34, no. 4, pp. 591–593, 2 pls. 1932. (Vague proboscidean resemblance.)

NOVIKOFF, K. L. Some biological observations on hamsters. Abstr. works zool. inst. Moscow State Univ., pp. 83–85. 1933. (In Russian.)

OMMANNEY, F. D. Do whales descend to great depths? Nature, London, vol. 135, no. 3411, pp. 429–430. March 16, 1935. (The limit of safety from 'caisson' sickness would probably be less than 200 fathoms.)

ORLOV, J. A. Neue Funde fossiler Säugetiere in Sibirien. Trudy Geologicheskogo Muzeia Akademii Nauk SSSR (Trav. Mus. Géol. Acad. Sci. URSS.), vol. 7, pp. 159–166, fig. 1. 1930. (In German.)

PATTE, ÉTIENNE. Comparaison des faunes de mamifères de Lang Son (Tonkin) et du Se Tchouen. Bull. Soc. Géol. France, Paris, ser. 4, vol. 28, no. 1–2, pp. 55–63, 3 figs. February, 1928.

PATTERSON, BRYAN. Upper premolar-molar structure in the Notoungulata with notes on taxonomy. Geol. Series Field Mus. Nat. Hist., Publ. 332, vol. 6, no. 6, pp. 91–111, figs. 10–22. December 31, 1934.

——— The auditory region of an upper Pliocene typotherid. Geol. Series Field Mus. Nat. Hist., Publ. 331, vol. 6, no. 5, pp. 83–89, figs. 7–9. December 31, 1934.

——— Cranial characters of *Homalodotherium*. Geol. Series Field Mus. Nat. Hist., Publ. 333, vol. 6, no. 7, pp. 113–117, fig. 23. December 31, 1934.

——— *Trachytherus*, a typotherid from the Deseado beds of Patagonia. Geol. Series Field Mus. Nat. Hist., Publ. 334, vol. 6, no. 8, pp. 119–139, figs. 24–28. December 31, 1934.

——— A new Argyrohippus from the Deseado beds of Patagonia. Geol. Ser. Field Mus. Nat. Hist., publ. 344, vol. 6, no. 12, pp. 161–166, figs. 34–35. May 15, 1935. (New: *Argyrohippus praecox.*)

PAVLOW, M. V. Rangifer tarandus et formes rapprochées. Biulleten' Moskovskogo Obshchestva Ispytatelei Prirody. Otdel Geologicheskii (Bull. Soc. Naturalistes Moscou., Sect. Geol., vol. 5, no. 2, pp. 137–170, pls. 1–2. 1927. (In French, with Russian summary; new: *Rangifer tarandus kloktun, R. tobolskiensis.*)

——— Les restes des ossements des mastodontes provenant de l'ancien gouvernement de Kherson. Trav. Inst. paléozool. Acad. Sci. USSR, Leningrad, vol. 1, pp. 69–80, pls. 2. 1932. (In French, with Russian summary.)

PEACOCK, E. H. In ambush for bison. (A big game photographer's fortune and misfortune in Burma.) Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, pp. 529–531, pls. 1–3. December 15, 1934. (*Bibos gaurus.*)

PETERS, H. Ein Bastard zwischen Yak und Rind. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, p. 166, pls. 12–13. March 1, 1932.

PETIT, G. Mammalia. Contribution à l'étude de la faune de Madagascar. Pt. 3. Faune Colonies Franç., Paris, vol. 4, no. 5, pp. 559–589. 1934. (New: *Ericulus (Echinops) telfairi nigrescens.*)

PETTERS, VIKTOR. Über einen bronzezeitlichen Haushund aus Nieder-Österreich. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 45–46. December 31, 1933.

PIVETEAU, JEAN. Observations sur un Mammifère artiodactyle, le *Dacrytherium ovinum*. Bull. Soc. géol. France, Paris, ser. 5, vol. 1, Comptes Rendus somm. Séances, fasc. 17, pp. 277–279. December 21, 1931.

PLEHANOFF, P. The determination of the ages of seals. Abstr. works zool. inst. Moscow State Univ., pp. 88–91, figs. 3. 1933. (In Russian.)

PRELL, H. Die gegenwärtig bekannten Arten der Gattung Chinchilla Bennett. Zool. Anz., Leipzig, vol. 108, nos. 5–6, pp. 97–104. November, 1934. (New: *Chinchilla velligera* for *C. lanigera* Bennett, 1829, preocc.)

PRITCHARD, A. L. Was the introduction of the muskrat to Graham Island, Queen Charlotte Islands, unwise? Canadian Field-Nat., vol. 48, no. 6, p. 103. September, 1934. (Probably.)

REVERDIN, L. Sur la faune du néolithique ancien et moyen des stations lacustres. Archiv. suisses Anthropol. gén., Genève, vol. 5, no. 1, pp. 41–46. 1928–1929.

RIEK, GUSTAV. Ergrabung paläolithischer Kulturen bei Stetten ob. Lontal: (Auffindung des ersten deutschen Aurignac-Schädels.) Der Biologe, München, vol. 1, no. 2, pp. 46–49. November, 1931. (Bone carvings representing mammoth, cave lion, horse, bison, bear.)

ROYO GOMEZ, José. Algunos vertebrados fósiles de la cuenca del Duero. Boletin Soc. Española Hist. Nat., vol. 34, no. 10, pp. 505–511, pls. 45–48, fig. 1. December, 1934.

RUSCONI, CARLOS. Algunos fósiles terciarios de la Gobernacion de la Pampa Argentina. Revista Chilena Hist. Nat., año 38 (1934), pp. 104–107, fig. 25. 1934. (New: *Diaphoromys fiegi*.)

——— Sobre la dentadura superior de algunos carpinchos extinguidos (Rodentia). Bol. Paleont. de Buenos Aires, no. 3, pp. 3–7, figs. 4. December 31, 1934.

RUSSELL, LORIS S. A middle Eocene mammal from British Columbia. Amer. Journ. Sci., ser. 5, vol. 29, no. 169, pp. 54–55, figs. 3. January, 1935. (A tillodont, *?Trogosus minor*.)

RYZIEWICZ, M. Z. Ovibos recticornis n. sp. Ein Beitrag zur Systematik der Unterfamilie Ovibovinae. Bull. Internat. Acad. Polonaise Sci. et Lettr. Cl. Sci. Math. et Nat., Sér. B: Sci. Nat. (II) [Zool.], 1933, nos. 1–5, pp. 71–87, 1 pl. 1933. (New: *Ovibos recticornis*.)

SAUNDERS, W. E. The saddle-backed shrew in Riding Mountain National Park. Canadian Field-Nat., vol. 49, no. 4, p. 76. April, 1935. (*Sorex arcticus*.)

SCHNEIDER, KARL MAX. Über einen Bison-Zebu-Mischling. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 160–165, pls. 10–11. March 1, 1932.

SCHREIBER, HANS. Röntgenologische Untersuchungen an der Handwurzel der Affen. Anat. Anz., vol. 78, nos. 20–24, pp. 369–429, 19 figs, 1 pl. September 24, 1934.

SCHULTZ, ADOLPH HANS. Eruption and decay of the permanent teeth in primates. Amer. Journ. Phys. Anthrop., vol. 19, no. 4, pp. 489–581, figs. 21. January–March, 1935.

SCHULTZ, C. BERTRAND. The geology and mammalian fauna of the Pleistocene of Nebraska. Pt. 2. The Pleistocene mammals of Nebraska. Nebraska State Mus., vol. 1, bull. 41, pp. 357–393, table 1. October, 1934.

——— and LOREN EISELEY. Paleontological evidence for the antiquity of the Scottsbluff bison quarry and its associated artifacts. Amer. Anthrop., n. s., vol. 37, pp. 306–319, pls. 8–9. April, 1935.

SCHWARZ, ERNST. The origin of African house rats. Proc. Zool. Soc. London for 1934, pt. 4, pp. 723–726. January, 1935.

SEVERTZOFF, S. A. On the dynamics of populations of vertebrates. Quart. Rev. Biol., vol. 9, no. 4, pp. 409–437. December, 1934.

SICKENBERG, O. Neue Ausgrabungen im Altplistozän von Hundsheim. Verh. zool. botan. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 46–48. December 31, 1933.

——— Die Säugetierfauna der Fuchs- oder Teufelslucken bei Eggenburg. Verh. zool. -bot. Ges. Wien, vol. 83, Ber. Sekt. f. Paläont. u. Abstam., pp. 31–38. December 31, 1933.

SIMPSON, GEORGE GAYLORD. Patagonian oasis. Natural History, New York, vol. 34, no. 6, pp. 541–553, figs. 1934.

——— Bibliography (March 30, 1925 to February 1, 1935). Privately printed by author, pp. 6.

SKUTIL, J., and A. STEHLIK. Moraviae fauna diluvialis. (A. Mammalia.) Sborník klubu přír. Brno, Brünn, vol. 14, pp. 102–178, figs. 7. (1931) 1932. (Occurrences listed alphabetically under each of the 125 recognized species. *Machairodus moravicus* Woldr. p. 134, a nomen nudum here.)

SMELSER, G. K., ARTHUR WALTON, and E. O. WHETHAM. The effect of light on ovarian activity in the rabbit. Journ. Exper. Biol., Edinburgh, vol. 11, no. 4, pp. 352–363. October, 1934.

STARCK, DIETRICH. Über den feineren Bau der Lebervenen von Hydrochoerus capybara. Anat. Anz., vol. 78, nos. 11–14, pp. 240–246, figs. 1–5. July 25, 1934.

STEPHEN, A. C. Pilot whale (*Globicephala melaena*) stranded in North Uist. Scottish Nat., no. 204, p. 183. November–December, 1933.

——— Whales stranded on the Scottish coast. Scottish Nat., no. 204, p. 183. November–December, 1933. (*Ziphius cavirostris* and *Mesoplodon bidens*.)

——— Lesser rorqual (*Balaenoptera acutorostrata*) in Kincardineshire. Scottish Nat., no. 204, p. 183. November–December, 1933.

STIRTON, R. A. A review of the Tertiary beavers. Univ. Calif. Publ. Bull. Dept. Geol. Sci., vol. 23, no. 13, pp. 391–458, figs. 142, 1 map, 2 charts. May 8, 1935. (New: *Agnotocastor*, *A. praetereadens*, *Monosaulax* for *Steneofiber pansus* Cope, *Eucastor dividerus*, *E. planus*.)

ST. LEGER, JANE. On some mammals collected by Dr. Drake-Brockman in Somaliland. Ann. and Mag. Nat. Hist., London, ser. 10, vol. 15, no. 90, pp. 666–673. June, 1935. (New: *Dipodillus juliani*.)

STOCK, CHESTER. Skull and dentition of the American Miocene cat, Pseudaelurus. Bull. Geol. Soc. America, vol. 45, pp. 1051–1058, pls. 129–130. December 31, 1934.

——— Artiodactyla from the Sespe of the Las Posas Hills, California. Publ. 453, Carnegie Inst. Washington (Contrib. Paleont.), pp. 119–126, pl. 1. July 20, 1935. (New: *Dyseotylopus*, *D. migrans*, *Hypertragulus fontanus*.)

——— Titanothere remains from the Sespe of California. Proc. Nat. Acad. Sci. Washington, vol. 21, no. 7, pp. 456–462, pls. 2. July, 1935. (New: *Teleodus californicus*.)

SZALAY, A. B. Weisse Bisons. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 121–142. March 1, 1932.

THOM, W. S. Tiger shooting in Burma. Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, pp. 573–603, pls. 1–2. December 15, 1934.

TIMOFEEFF, V. K. The island Barsa-Kelmess and its mammalia. Abstr. works zool. inst. Moscow State Univ., pp. 85–88. 1933. (In Russian.)

TINDALE, NORMAN B. Tantanoola caves, south-east of South Australia: Geological and physiographical notes. Trans. and Proc. Roy. Soc. S. Australia, Adelaide, vol. 57, pp. 130–142, figs. 7. December 23, 1933. (Remains of marsupials, rodents, and dingo.)

VILLALTA COMELLA, J. F. DE, and M. CRUSAFONT PAIRÓ. Primera nota sobre vertebrats fòssils miocènics del Vallès. La presència del *Dinotherium giganteum* Kaup var. *laevius* Jourdan a Sant Quirze de Galliners. Butll. Inst. Catalana Hist. nat., Barcelona, vol. 33, nos. 4–5, pp. 258–261, pl. 11. 1933.

VŒLCKER, ILSE. Beiträge zum Oberrheinischen Fossilkatalog Nr. 3. *Felis issiodorensis* Croizet von Mauer a. d. E[lsenz]. Sitz.-ber. Heidelberg. Akad. Wiss. Math.-Naturw. Kl., 1930, no. 12, pp. 3–8, 1 fig. July 24, 1930.

WATTS, JAMES W. A comparative study of the anterior cerebral artery and the circle of Willis in primates. Journ. Anat., Cambridge, vol. 68, pt. 4, pp. 534–550, figs. 1–13. July, 1934.

WAYLAND, E. J. Deinotherium in the Pleistocene. Nature, London, vol. 129, no. 3244, p. 24. January 2, 1932. (Africa.)

WEHRLI, HANS. Bachitheriumfund aus dem Meeressand von Weinheim bei Alzey und kritische Bemerkungen zur Systematik und Stammesgeschichte der Bachitherien. Notizbl. Ver. Erdk. u. hess. geol. Landesanst. zu Darmstadt f. 1931–1932, ser. 5, vol. 14, pp. 101–107, figs. 3, pl. 9. 1933.

WEITZEL, KARL. Kopidodon macrognathus Wittich, ein Raubtier aus dem Mitteleozän von Messel. Notizbl. Ver. Erdk. u. hess. geol. Landesanst. f. 1931–1932, Darmstadt, ser. 5, vol. 14, pp. 81–88, pl. 7. 1933. (New: *Kopidodon* for *Cryptopithecus macrognathus* Wittich.)

WESTBERG, GUSTAV V. Der Wisent in Bialowies im letzten Viertel des vorigen Jahrhunderts. Ber. internat. Ges. Erhaltung des Wisents, Berlin, vol. 3, no. 3, pp. 143–159. March 1, 1932.

WHEELER, J. F. G. On the stock of whales at South Georgia. Discovery Reports, Cambridge, vol. 9, pp. 351–372, figs. 3. December, 1934.

WHEELER, WILLIAM MORTON, CLINTON V. MACCOY, LUDLOW GRISCOM, GLOVER M. ALLEN, AND HAROLD J. COOLIDGE, JR. Observations on the behavior of animals during the total solar eclipse of August 31, 1932. Proc. Amer. Acad. Arts and Sci., vol. 70, no. 2, pp. 33–70, map. March, 1935.

WILLIAMS, J. Social behaviour of bison (*Bibos gaurus* H. Smith). Journ. Bombay Nat. Hist. Soc., vol. 37, no. 3, pp. 724–726. December 15, 1934.

WOOD, ALBERT ELMER. Evolution and relationship of the heteromyid rodents with new forms from the Tertiary of western North America. Annals Carnegie Mus., vol. 24, pp. 73–262, figs. 157. May 13, 1935. (New: *Heliscomys hatcheri*, *Heliscomys senex*, *Mookomys formicorum* [sic], *Perognathoides* for *Diprionomys quartus* Hall, *Perognathus coquorum*, *Cupidinimus*, *C. nebraskensis*, *Dipodomys gidleyi*, *Proheteromys matthewi*, *Diprionomys agrarius*.)

WODZICKI, K. Beitrag zur Kenntnis der neolithischen und mittelalterlichen Ziegen aus Polen. Bull. Internat. Acad. Polonaise Sci. et Lettr. Cl. Sci. Math. et Nat., Sér. B: Sci. Nat. (II) [Zool.]. 1933, nos. 1–5, pp. 89–107, pl. 6. 1933. (*Capra aegagrus* and *C. prisca*.)

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